Nokia Customer Care

Service Manual

RM-320 (Nokia N95 8GB; L3&4)
Mobile Terminal
Part No: (Issue 1)

COMPANY CONFIDENTIAL

Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	08/2007	M. Hautaniemi	

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IMPORTANT

This document is intended for use by qualified service personnel only.

Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.

ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

Nokia N95 8GB; L3&4 Service Manual Structure

1 General Information
2 Service Tools and Service Concepts
3 BB Troubleshooting and Tuning Guide
4 RF troubleshooting
5 Camera Module Troubleshooting
6 System Module

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1 — General Information

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RM-320 product selection

RM-320 is a WCDMA/GSM dual mode handportable phone, supporting EGSM850/900/1800/1900 and WCDMA2100.

RM-320 is a 3GPP Release 5 terminal supporting WCDMA/HSDPA, EGPRS and GPRS data bearers. For WCDMA HSDPA the maximum bit rate is up to 3.6 Mbps for downlink and 384 kbps for uplink with simultaneous CS speech or CS video (max. 64 kbps).

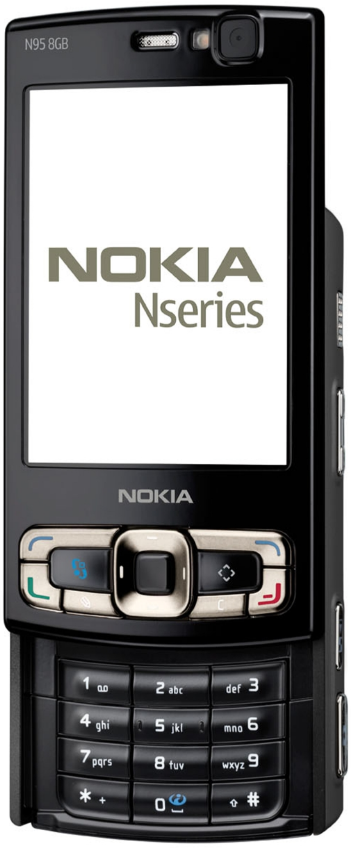
For 2G and 2.5G networks the RM-320 is a Class A EGPRS DTM MSC 11 which means maximum download speed of up to 236.8 kbps simultaneously with speech or Class B EGPRS MSC 32 which means a in maximum download speed of up to 296kbit/s with EGPRS, and up to 107kbit/s with GPRS.

According to GSM standard 05.05 it responds to class 4 (max. 2W) in GSM 850 and EGSM 900 class 1 (1W) in DCS 1800 and class 1 in PCS 1900. RM-320 supports EGPRS (EDGE) class B as well as Bluetooth 2.0 EDR standard.

RM-320 supports two way video calls with two integrated cameras, one on the front and one on the back.

RM-320 is an MMS (Multimedia Messaging Service) enabled multimedia computer with a large 2.6'' QVGA (240 x 320 pixels) TFT colour display and an integrated 5 Megapixel auto focus camera. The MMS implementation follows the OMA MMS standard release 1.2. The Browser is a highly advanced internet browser also capable of viewing operator domain XHTML Mobile Profile (MP) content.

RM-320 uses Symbian 9.2 operating system and supports also MIDP Java 2.0 & CLDC1.1, providing a good platform for compelling 3rd party applications.



RM-320 product features and sales package

Imaging

Main camera:

- Sensor: CMOS, 5 megapixel
- Carl Zeiss Optics: Tessar™ lens
- F number/Aperture: F2.8
- Focal length: 5.6 mm
  35 mm (35 mm equiv.)
- Focus range: 10 cm ~ infinity
- Macro focus distance: 10-50 cm
- Shutter speed: Mechanical shutter 1/1000~1/4 s
- Lens protection: Sliding cover with activation

Video:

- Video resolution: up to VGA at 30 fps
- Audio recording: AAC (AMR for MMS)
- Video stabilization
- Video clip length: 59 min 59 sec
- Video file format: .mp4 (default) , .3gp (for MMS)
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: Auto, Night
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (optical/digital): 1x / up to 10x (VGA 4X)

Photo:

- Still image resolutions: up to 5 megapixel: 2592 x 1944
- Still image file format: JPEG/EXIF
- Auto focus
- Auto exposure: center weighted AE
- Image orientation: automatic
- Exposure compensation: +2 ~ -2EV at 0.5 step
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: auto, sports, portrait, close-up, landscape, night, user defined
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (digital): up to 20x (5Mpix 6X)

Other camera features:

- LED flash and recording indicator
- Front camera, CIF (352 x 288) sensor

Edit

- On device Photo editor and Video editor (manual & automatic)

View

- Large 2.8” QVGA (240 x 320 pixels) TFT colour display, ambient light detector - used to optimize display and keypad backlight brightness and power consumption
- Slideshow from Gallery

Share

- Nokia XpressShare - share effortlessly from Gallery or after capture via Email, Bluetooth, MMS or IrDA
- Direct connection to TV via cable or WLAN (UPnP)
- Video call and video sharing support. (WCDMA services)
- Online Album : Image/Video uploading from Gallery

Print

- Nokia XpressPrint – direct printing via USB (PictBridge), Bluetooth (BPP), and WLAN (UPnP

Store

- Nokia XpressTransfer – easy to transfer and organize photos and video between your device and a compatible PC
- Photoshop Album 3.0 Starter Edition (PC)
- Nokia Lifeblog (mobile & PC)

Music

- Digital music player: supports MP3/AAC/M4A/WMA with playlists
- Dedicated music keys
- OMA DRM 2.0 & WMDRM support for music
- Stereo FM radio (87.5-108MHz)
- Integrated stereo handsfree speakers
- Stereo headset HS-45 & music remote AD-43

Media

- Mobile TV experience with video streaming
- Full web browser support (HTML)
- Visual Radio™ support

Productivity

Messaging:

- E-mail (SMTP, IMAP4, POP3), MMS, SMS

Office applications:

- Viewing of email attachments – .doc, .xls, .ppt, . pdf

PIM:

- Contacts, calendar, to-do, notes, recorder, calculator, clock, converter

Synchronization:

- Local/Remote (using SyncML)
    - Data: Calendar, Contacts, To-do, Notes, E-mail
    - PC Applications: Microsoft Outlook (98, 2000, 2002, 2003), Outlook Express, Lotus Organizer (5.0, 6.0), Lotus Notes (5.0, 6.0)

Call management:

- Call logs, speed dial, voice dialling (with SIND) and voice commands
- Nokia Push to Talk (PoC)

Connectivity

- WLAN - IEEE802.11 g/b with UPnP support
- Mini USB type B interface with USB 2.0 full speed
- 3.5mm stereo headphone plug and TV out support (PAL/NTSC)
- Bluetooth wireless technology 2.0 with A2DP stereo audio
- Infrared (SIR)

Add-on software framework

- Symbian 9.2 OS
- Nokia Series 60, 3rd edition, feature pack 3.1
- Java: MIDP2.0
- C++ and Java SDKs

Additional technical specifications

- Vibrating alert
- 3GPP Rel 5 compliant
- Speech codecs supported in WCDMA: AMR
- Speech codecs supported in GSM: FR AMR/HR AMR/EFR/FR/HR
- WCDMA HSDPA 2100 MHz with simultaneous voice and packet data (PS max speed DL/UL= 3.6Mbps/ 384kbps, CS max speed 64kbps)
- Dual Transfer Mode (DTM) support for simultaneous voice and packet data connection in GSM/EDGE networks. Simple class A, multi slot class 11, max speed DL/UL: 118.4/118.4kbits/s
- EGPRS class B, multi slot class 32, (5 Rx + 3 Tx / Max Sum 6), max speed DL/UL= 296 / 177.6 kbits/s
- GPRS class B, multi slot class 32 (5 Rx + 3 Tx / Max Sum 6), max speed DL/UL= 107 / 64.2 kbits/s
- GPS

Sales package

- Transceiver RM-320
- Charger (AC-5)
- Battery (BL-6F)
- Music headset (HS-45 and AD-54)
- Connectivity cable (DKE-2)
- Video out cable (CA-75U)

■ Mobile enhancements

Table 1 Audio

Enhancement	Type
Music headset	HS-45 with AD-54 3.5mm stereo plug
Basic headset	HS-41
Stereo headset	HS-48
Wireless headset	HS-26W

Enhancement	Type
Bluetooth headset	BH-900
	BH-800
	STEREO BH-501
	BH-601
	MONO BH-200
	BH-202
	BH-207
	BH-300
	BH-302
	BH-500
	BH-600
	BH-700
	BH-801
Wireless stereo gateway	AD-42W
Music headphone	HS-61
Advanced headphone	HS-62
Music speaker	MD-3
Mini speaker	MD-4

Table 2 Car

Enhancement	Type
Mobile charger	DC-4
Wireless plug-in car handsfree	HF-6W
	HF-33W
	HF-35W
Car kit	Nokia 616
Multimedia car kit	CK-20W

Table 3 Data

Enhancement	Type
Connectivity cable	DKE-2
Video connectivity cable	CA-75U

Table 4 GPS

Enhancement	Type
Wireless GPS module	LD-3W
Navigation pack	LD-2

Table 5 Messaging

Enhancement	Type
Digital pen	SU-27W
Wireless keyboard	SU-8W

Table 6 Power

Enhancement	Type
Battery 1200mAh Li-ion	BL-6F
Travel charger	AC-4
	AC-5
Charger adapter	CA-44

Table 7 Carrying

Enhancement	Type
Carrying case	

Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm3)
Transceiver with BL-6F 1200mAh li-ion battery back	99 x 53 x 19-21	~ 120	90

Main RF characteristics for GSM850/900/1800/1900 and WCDMA 2100 phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, WCDMA 2100

Parameter	Unit
Rx frequency band	GSM850: 869 - 894MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA2100: 2110 - 2170 MHz
Tx frequency band	GSM850: 824 - 849MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA2100: 1920 - 1980 MHz
Output power	GSM850: +5 ...+33dBm/3.2mW ... 2W
	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W
	WCDMA -50 ... 24 dBm
Number of RF channels	GSM850: 124
	GSM900: 174
	GSM1800: 374
	GSM1900: 299
Number of WCDMA channels	WCDMA: 277
Channel spacing	200 kHz
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16

Battery endurance

Battery BL-6F 1200 mAh	
Music Playback time	10.5 h
Talk time (GSM/UMTS)	4.9/3.4 h
Standby time (GSM/UMTS)	188 / 228 h
Video Playback time	5h 14min
Video Call	1.91 h
Still Images without charging	372 images
Video Recording	2h 6min

Battery BL-6F 1200 mAh	
Browse time (3G)	4.3 h

Charging times

AC-5
1h 30 min

2 — Service Tools and Service Concepts

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Figure 14 Service concept for RF testing and RF/BB tuning 2–28

Service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-320, refer to various concepts.

	CA-31D	USB cable	
	The CA-31D USB cable is used to connect FPS-10 or FPS-11 to a PC. It is included in the FPS-10 and FPS-11 sales packages.		
	CA-35S	Power cable	
	CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.		

CU-4	Control unit	

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

Instructions

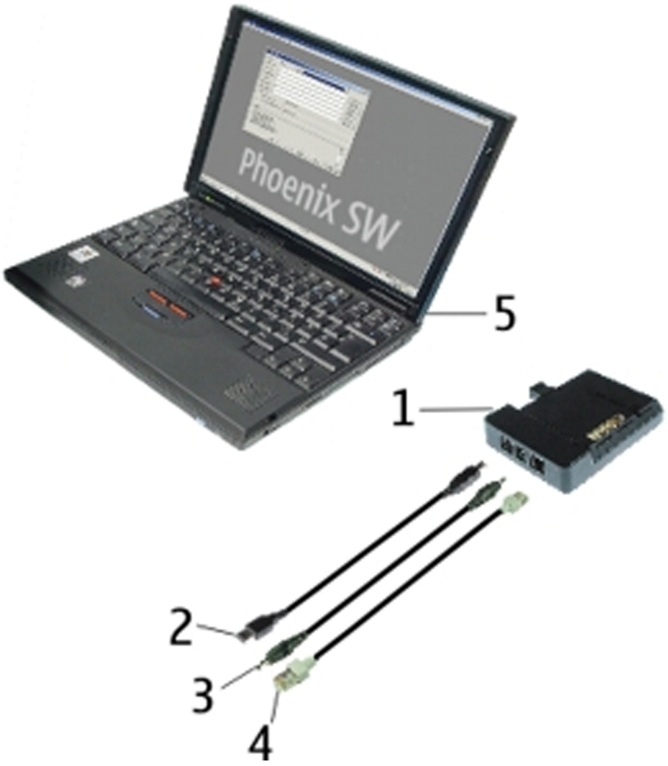
1 Connect a service tool (jig, flash adapter) to CU-4.

2 Connect CU-4 to your PC with a USB cable.

3 Connect supply voltage (12 V)

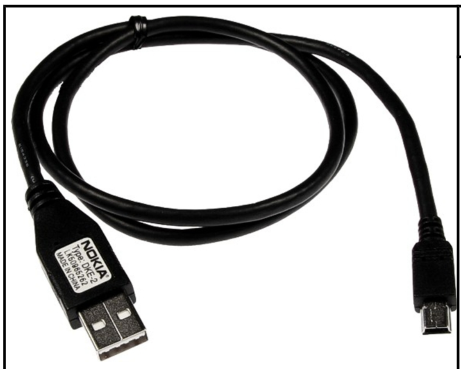
4 Connect an FBUS cable (if necessary).

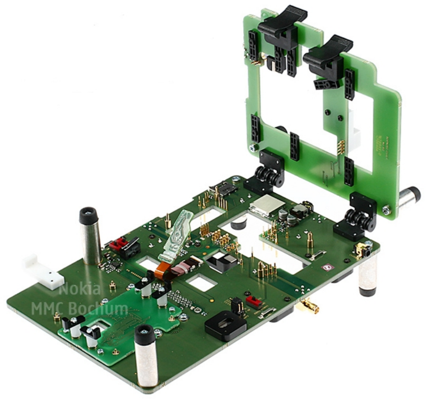
5 Start Phoenix service software.

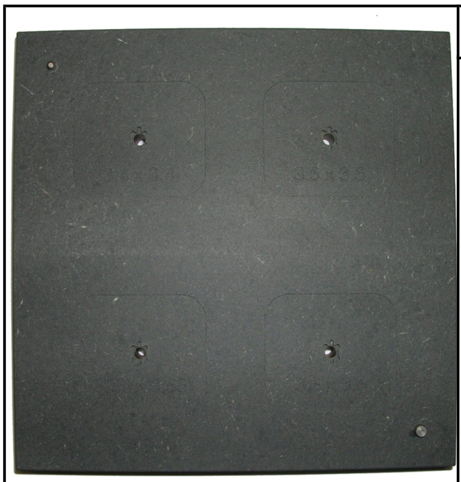
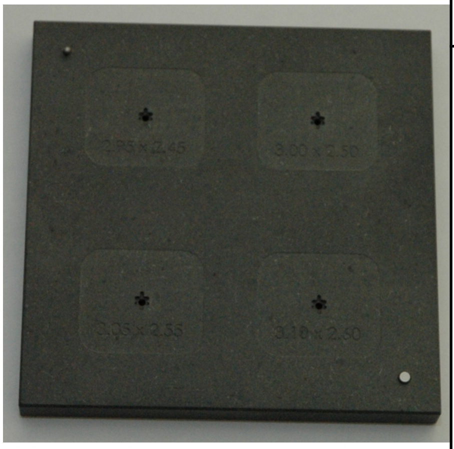
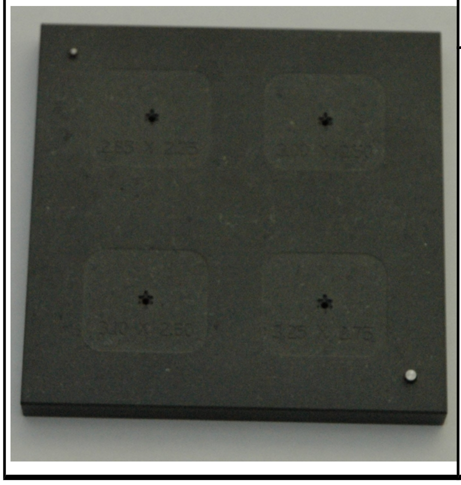


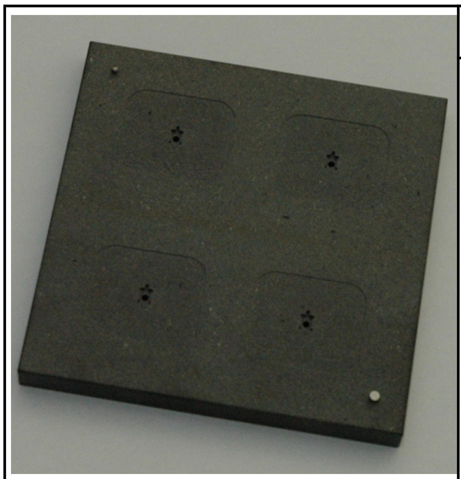
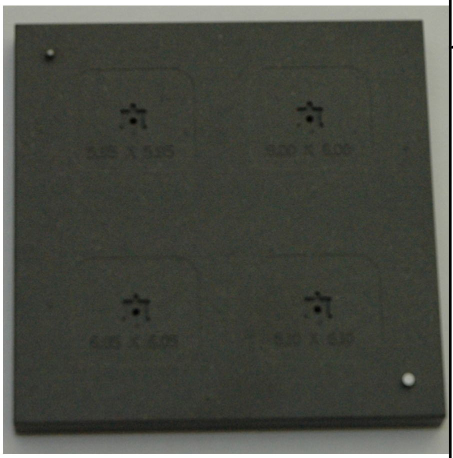
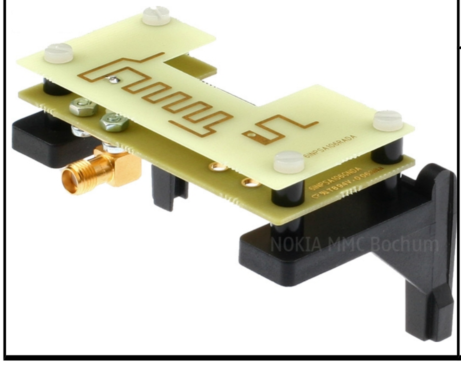
Note: Phoenix enables CU-4 regulators via USB when it is started.

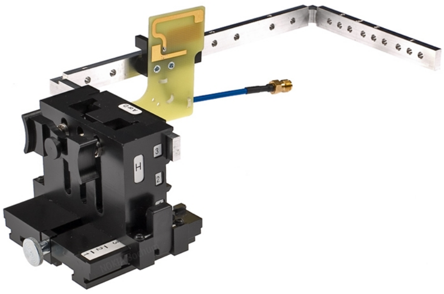
Reconnecting the power supply requires a Phoenix restart.

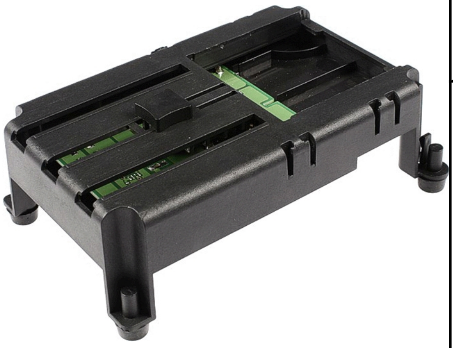
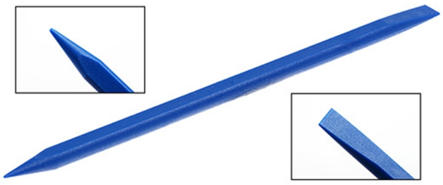
<table>
<tr><td rowspan="2"></td><td>DKE-2</td><td>Mini-USB cable</td><td></td></tr>
<tr><td colspan="3">USB to mini-USB connector cable.</td></tr>
<tr><td rowspan="2"> </td><td>FPS-10</td><td>Flash prommer</td><td></td></tr>
<tr><td colspan="3">FPS-10 interfaces with:
• PC
• Control unit
• Flash adapter
• Smart card
FPS-10 flash prommer features:
• Flash functionality for BB5 and DCT-4 terminals
• Smart Card reader for SX-2 or SX-4
• USB traffic forwarding
• USB to FBUS/Flashbus conversion
• LAN to FBUS/Flashbus and USB conversion
• Vusb output switchable by PC command
FPS-10 sales package includes:
• FPS-10 prommer
• Power Supply with 5 country specific cords
• USB cable
Note: FPS-21 is substitute FPS-10 if FPS-10 has not been set up.</td></tr>
<tr><td rowspan="2"> </td><td>FS-70</td><td>Flash adapter</td><td></td></tr>
<tr><td colspan="3">Flash adapter FS-70 is used for phone testing and flashing. FS-70 is used with the generic flash adapter base SS-60/62 and control unit CU-4 or interface adapter SS-46.
When flashing or system testing the phone, the adapter is attached to replace the phone own battery.
All functions (as well as the calibration voltages, current and the protections for over voltages, over current and voltage polarity), are performed by CU-4.
Flash adapter FS-70 main features:
• VBATT supply interface
• USB / FBUS multiplexed interface to the phone</td></tr>
</table>

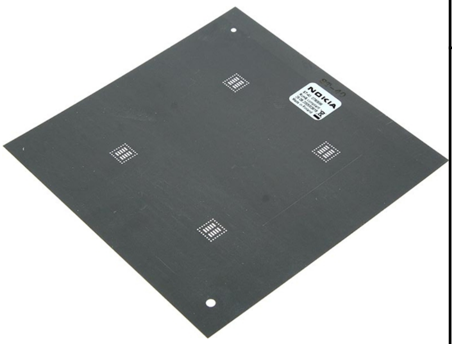
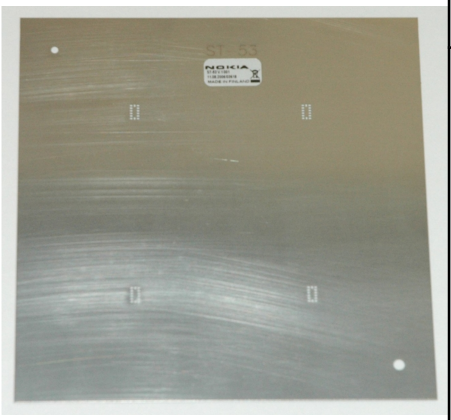
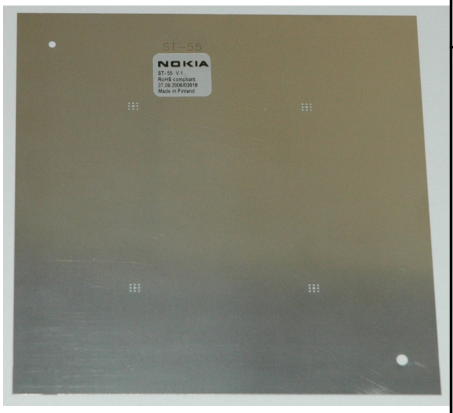
<table>
<tr><td rowspan="2">
</td><td>MJ-102</td><td>Module jig</td><td></td></tr>
<tr><td colspan="3">MJ-102 can be used for flashing as well as for RF, battery and system testing.
MJ-102 main functions:
• CU-4 interface adapter to phone
• FBUS interface to phone
• UI Interface to phone
• WCDMA and GSM RF-interface
All functions are performed in CU-4 e.g. calibration voltages and currents both all protections (over current, over voltage and voltage polarity).
MJ-102 contains following interfaces to phone:
• VBATT interface
• UI interface containing Display connector
• WCDMA and GSM RF interfaces
• Bluetooth RF interface
• Earpiece interface
• IHF speaker interface
• Microphone interface</td></tr>
<tr><td rowspan="2"> </td><td>PCS-1</td><td>Power cable</td><td></td></tr>
<tr><td colspan="3">The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.</td></tr>
<tr><td rowspan="2">
</td><td>PKD-1</td><td>SW security device</td><td></td></tr>
<tr><td colspan="3">SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC.
Without the device, it is not possible to use the service software.
Printer or any such device can be connected to the PC through the device if needed.</td></tr>
</table>

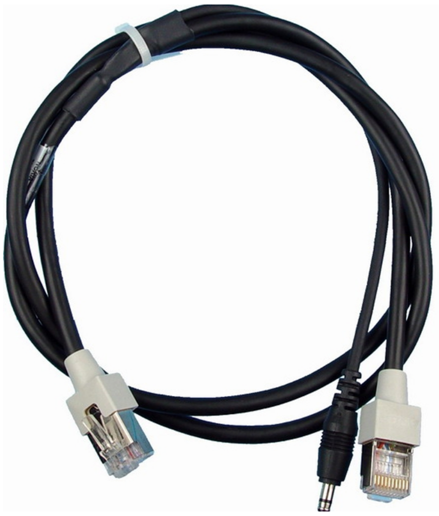
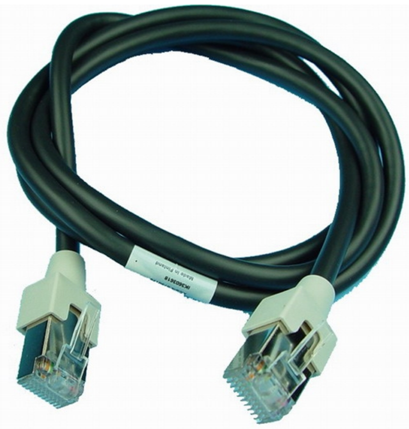
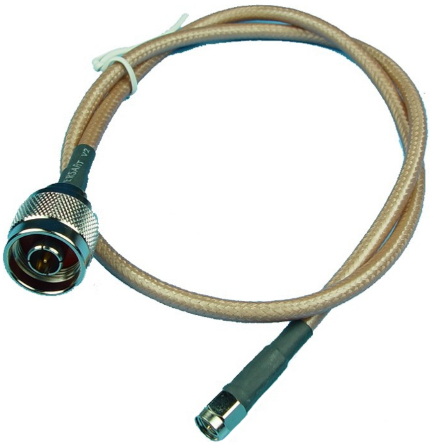
	RJ-105	Rework jig	
	RJ-105 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-38 stencil.		
	RJ-118	Soldering jig	
	RJ-118 is a soldering jig used for soldering and as a rework jig for the engine module.		
	RJ-157	Rework jig	
	RJ-157 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-55 stencil.		
	RJ-160	Rework jig	
	RJ-160 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-55 stencil.		

<table>
<tr><td rowspan="2"></td><td>RJ-166</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-166 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-53 stencil.</td></tr>
<tr><td rowspan="2"></td><td>RJ-169</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-169 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-59 stencil.</td></tr>
<tr><td rowspan="2"> </td><td>RJ-93</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-93 is a rework jig used with ST-40.</td></tr>
<tr><td rowspan="2"> </td><td>SA-106</td><td>RF coupler</td><td></td></tr>
<tr><td colspan="3">SA-106 is an RF coupler for WCDMA and GSM RF testing. It is used together with the product-specific flash adapter.</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td>SA-131</td><td>RF coupler</td><td></td></tr>
<tr><td colspan="3">SA-131 is a generic device for GPS testing. It is used together with SS-62.</td></tr>
<tr><td rowspan="2"> </td><td>SB-6</td><td>Bluetooth tester</td><td></td></tr>
<tr><td colspan="3">The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth.</td></tr>
<tr><td rowspan="2"> </td><td>SB-7</td><td>WLAN test box</td><td></td></tr>
<tr><td colspan="3">WLAN test requires defined position for the device.</td></tr>
<tr><td rowspan="2"> </td><td>SPS-2</td><td>Soldering paste spreader</td><td></td></tr>
<tr><td colspan="3"></td></tr>
</table>

<table>
<tr><td rowspan="2"> </td><td>SRT-6</td><td>Opening tool</td><td></td></tr>
<tr><td colspan="3">SRT-6 is used to open phone covers.</td></tr>
<tr><td rowspan="2"> </td><td>SS-46</td><td>Interface adapter</td><td></td></tr>
<tr><td colspan="3">SS-46 acts as an interface adapter between the flash adapter and FPS-10.</td></tr>
<tr><td rowspan="2"></td><td>SS-62</td><td>Generic flash adapter base for BB5</td><td></td></tr>
<tr><td colspan="3">generic base for flash adapters and couplers
SS-62 equipped with a clip interlock system
provides standardised interface towards Control Unit
provides RF connection using galvanic connector or coupler
multiplexing between USB and FBUS media, controlled by VUSB</td></tr>
<tr><td rowspan="2"></td><td>SS-93</td><td>Opening tool</td><td></td></tr>
<tr><td colspan="3">SS-93 is used for opening JAE connectors.</td></tr>
</table>

<table>
<tr><td rowspan="2"> </td><td>ST-38</td><td>Rework stencil</td><td></td></tr>
<tr><td colspan="3">ST-38 is a rework stencil used with rework jig RJ-105.</td></tr>
<tr><td rowspan="2"> </td><td>ST-40</td><td>Rework stencil</td><td></td></tr>
<tr><td colspan="3">ST-40 is a rework stencil and used with RJ-93.</td></tr>
<tr><td rowspan="2"> </td><td>ST-53</td><td>Rework stencil</td><td></td></tr>
<tr><td colspan="3">ST-53 is a rework stencil used with rework jig RJ-166.</td></tr>
<tr><td rowspan="2"> </td><td>ST-55</td><td>Rework stencil</td><td></td></tr>
<tr><td colspan="3">ST-55 is a rework stencil used with rework jig RJ-157 and RJ-160.</td></tr>
<tr><td rowspan="2"></td><td>ST-59</td><td>Rework stencil</td><td></td></tr>
<tr><td colspan="3">ST-59 is a rework stencil used with rework jig RJ-169.</td></tr>
</table>

<table>
<tr><td rowspan="2"> </td><td>SX-4</td><td>Smart card</td><td></td></tr>
<tr><td colspan="3">SX-4 is a BB5 security device used to protect critical features in tuning and testing.
SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed.</td></tr>
<tr><td rowspan="2"></td><td>XCS-1</td><td>Service cable</td><td></td></tr>
<tr><td colspan="3">The XCS-1 service cable is used to connect FLS-4S to the POS flash adapter for supplying a controlled operating voltage and data connection.</td></tr>
<tr><td rowspan="2"></td><td>XCS-4</td><td>Modular cable</td><td></td></tr>
<tr><td colspan="3">XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.</td></tr>
<tr><td rowspan="2"></td><td>XRS-6</td><td>RF cable</td><td></td></tr>
<tr><td colspan="3">The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.
SMA to N-Connector approximately 610 mm.
Attenuation for:
• GSM850/900: 0.3+-0.1 dB
• GSM1800/1900: 0.5+-0.1 dB
• WLAN: 0.6+-0.1dB</td></tr>
</table>

Service concepts

POS (Point of Sale) flash concept

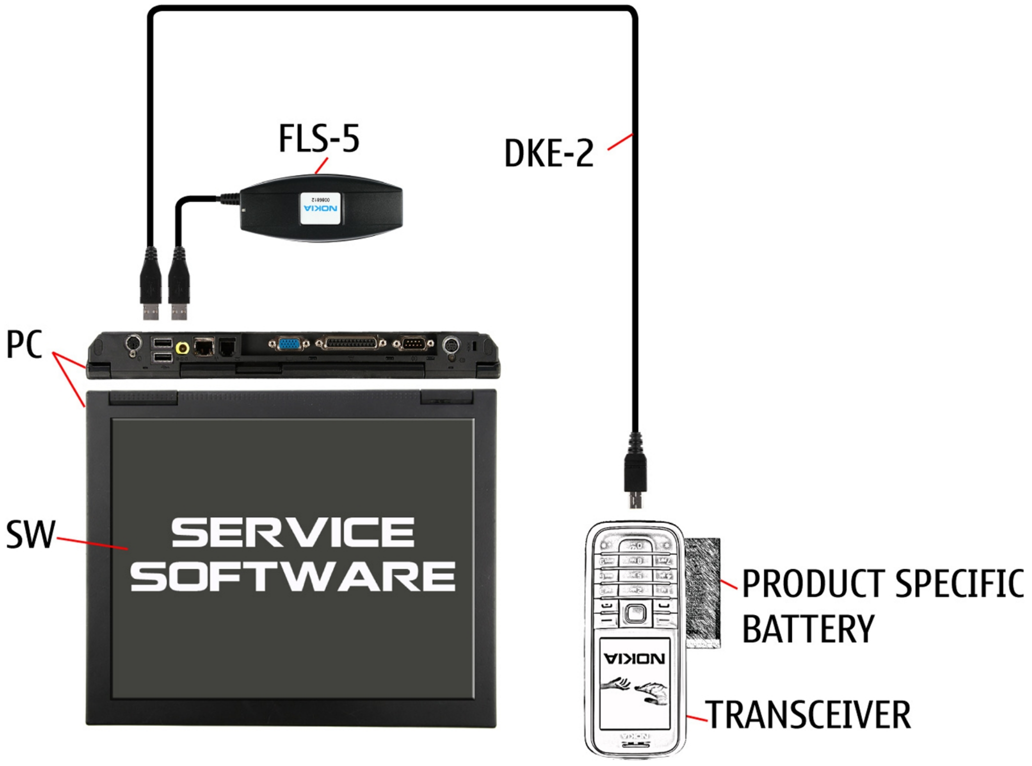

FLS-5
DKE-2
PC
SW
SERVICE SOFTWARE
PRODUCT SPECIFIC BATTERY
TRANSCEIVER

Figure 1 POS flash concept

Type	Description
Product specific tools	
BL-6F	Battery
Other tools	
FLS-4S or FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
DKE-2	USB connectivity cable

Flash concept with FPS-10

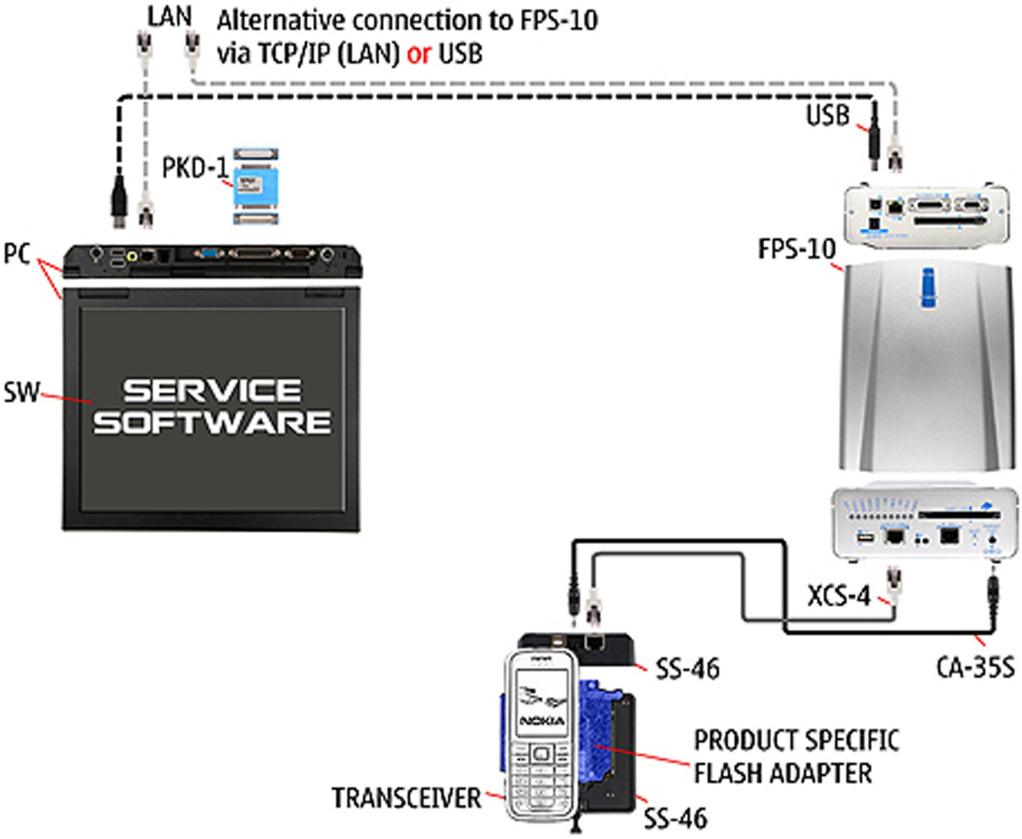

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
PC
FPS-10
SW
SERVICE
SOFTWARE
XCS-4
SS-46
CA-35S
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
SS-46

Figure 2 Basic flash concept with FPS-10

Type	Description
Product specific devices	
FS-70	Flash adapter
Other devices	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable
	USB cable

CU-4 flash concept with FPS-10

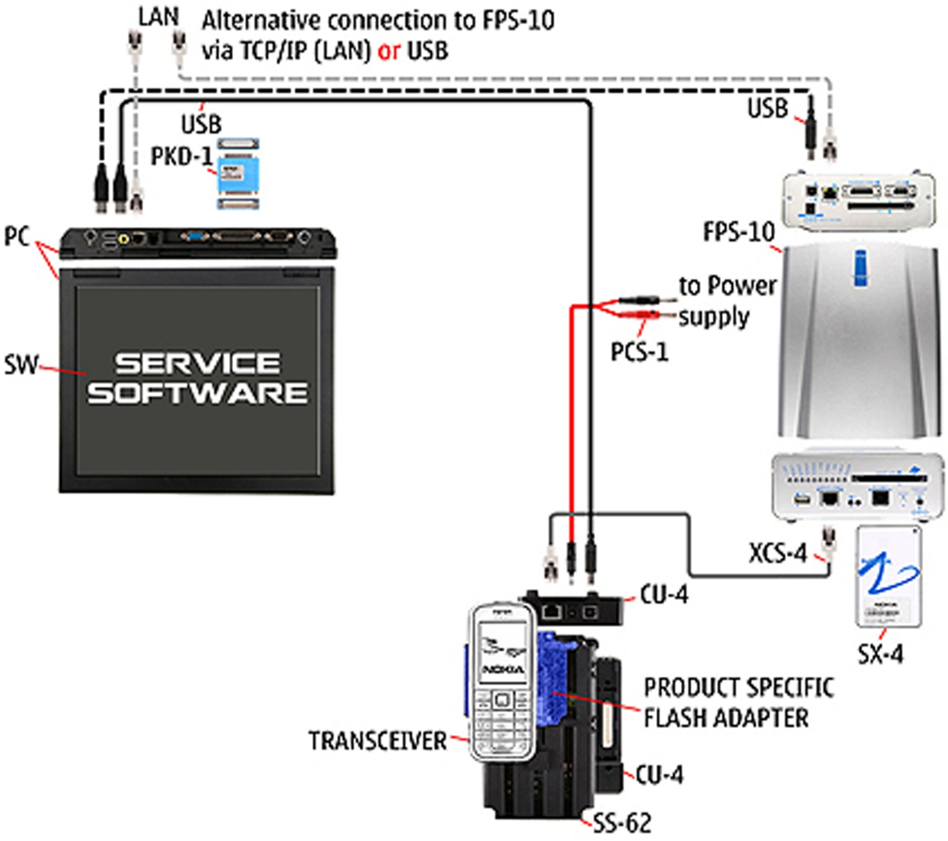

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
USB
PC
SW
SERVICE
SOFTWARE
FPS-10
to Power
supply
PCS-1
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
CU-4
SS-62

Figure 3 CU-4 flash concept with FPS-10

Type	Description
Product specific devices	
FS-70	Flash adapter
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	
PCS-1	Power cable
XCS-4	Modular cable
	Standard USB cable
	USB cable

Flash concept with FPS-10 and JBT-9

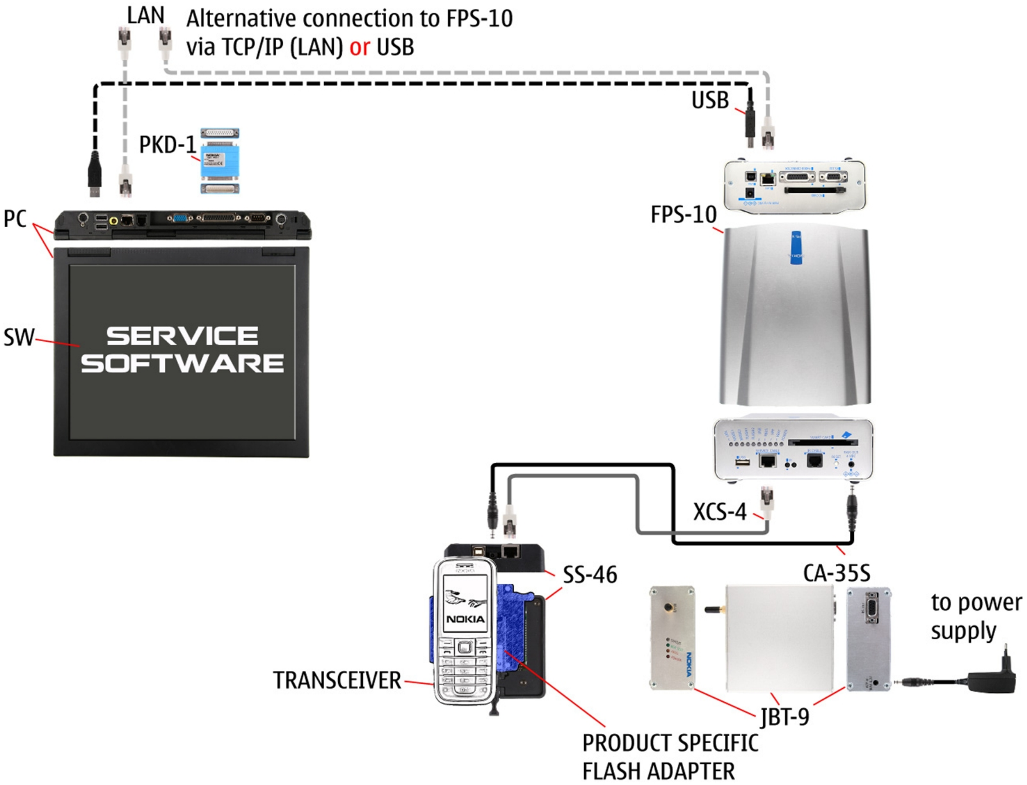

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
PC
FPS-10
SW
SERVICE
SOFTWARE
XCS-4
SS-46
CA-35S
to power
supply
TRANSCEIVER
JBT-9
PRODUCT SPECIFIC
FLASH ADAPTER

Figure 4 Flash concept with FPS-10 and JBT-9

Type	Description
Product specific tools	
FS-70	Flash adapter
Other tools	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
JBT-9	Bluetooth test and interface box
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable
	USB cable

Flash concept with SS-46 and CA-89DS

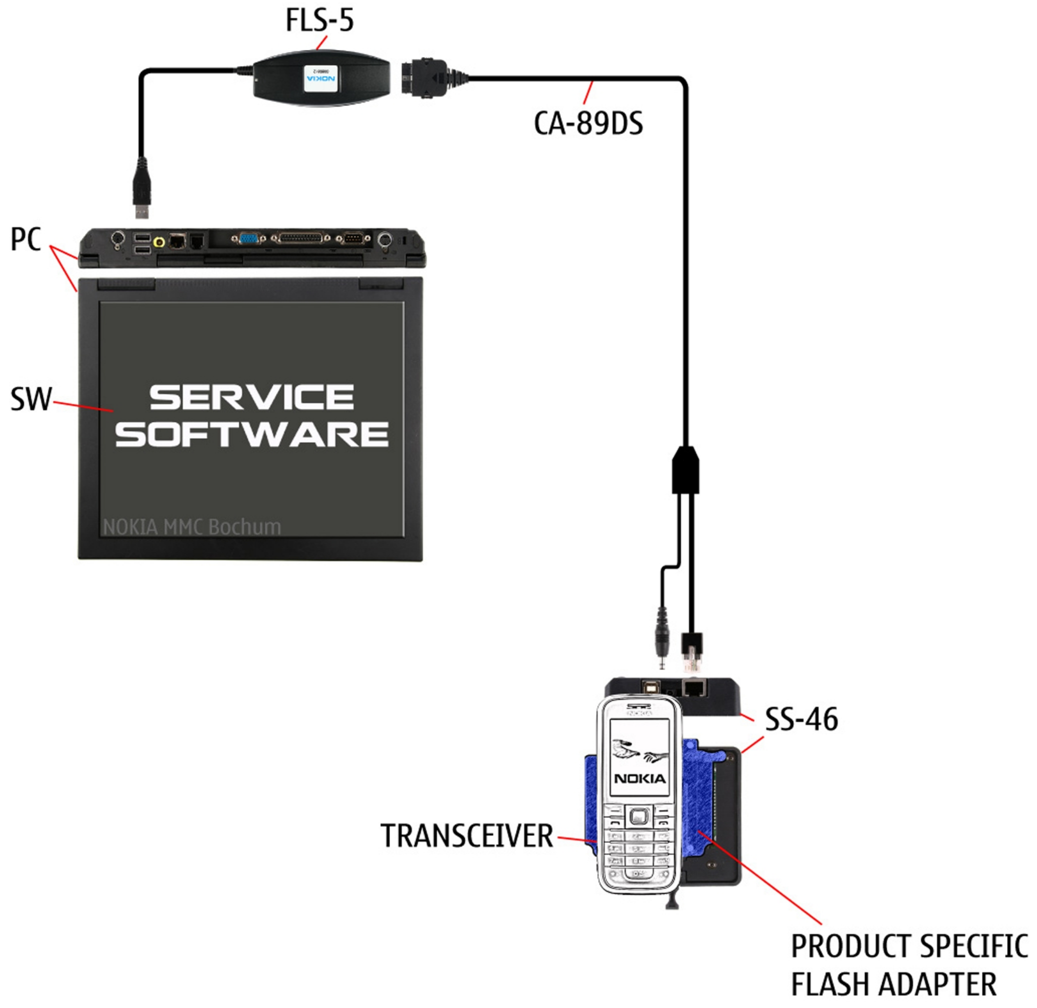

FLS-5
CA-89DS
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
SS-46
TRANSCEIVER
PRODUCT SPECIFIC FLASH ADAPTER

Figure 5 Flash concept with SS-46 and CA-89DS

Type	Description
Product specific tools	
FS-70	Flash adapter
Other tools	
FLS-5	Flash device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
CA-89DS	Cable

Flash concept with CA-89DS

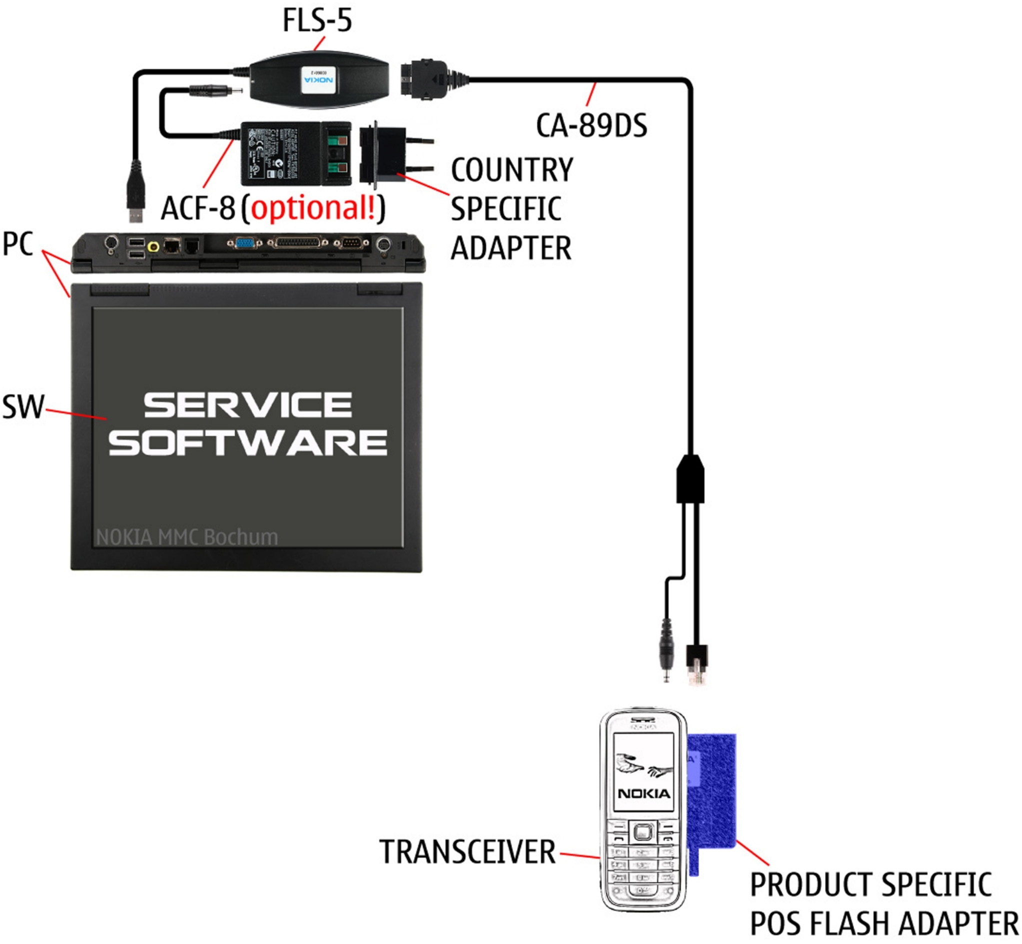

FLS-5
CA-89DS
COUNTRY SPECIFIC ADAPTER
ACF-8 (optional!)
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
TRANSCEIVER
PRODUCT SPECIFIC POS FLASH ADAPTER

Figure 6 Flash concept with CA-89DS

Type	Description
Product specific tools	
FS-70	Flash adapter
Other tools	
FLS-5	Flash device
	PC with Phoenix service software
Cables	
CA-89DS	Cable

Flash concept with SS-62 and CA-89DS

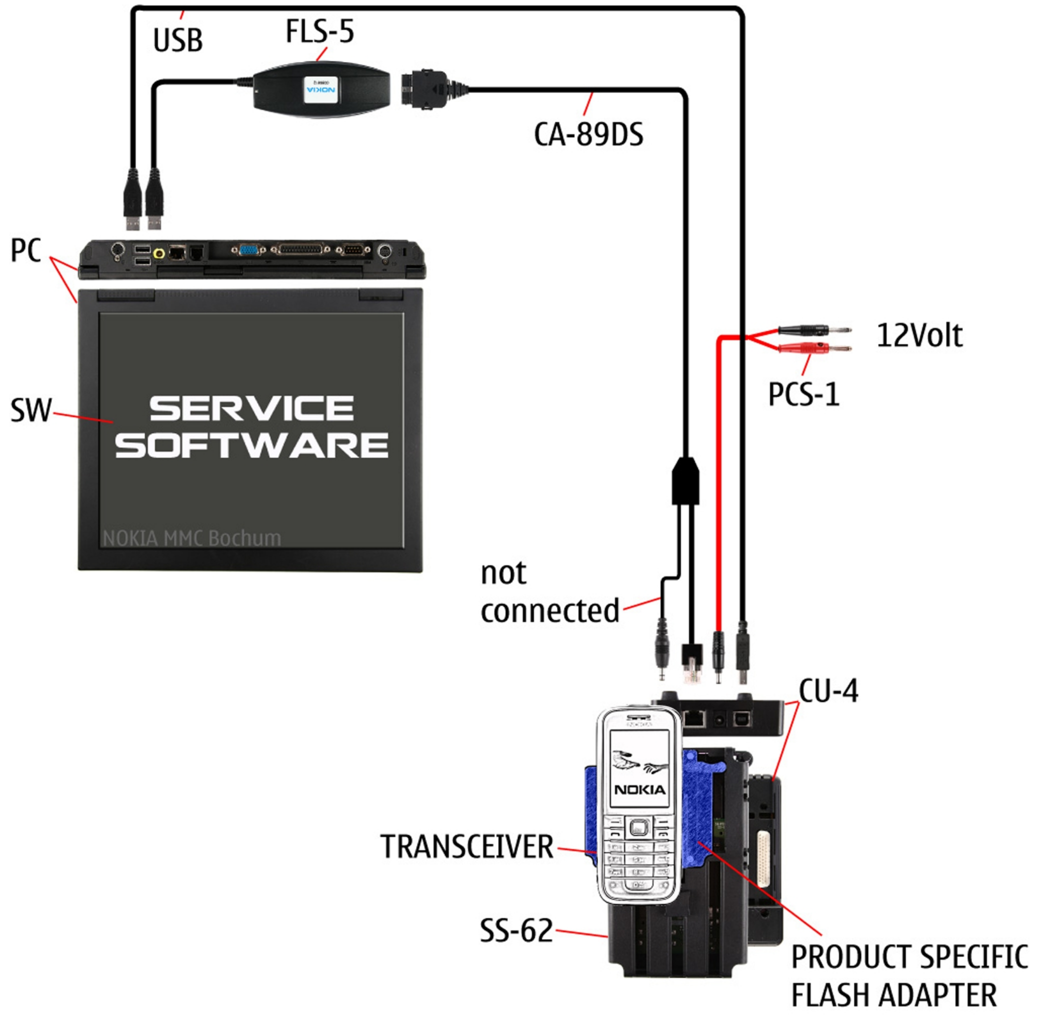

USB
FLS-5
CA-89DS
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
12Volt
PCS-1
not connected
CU-4
TRANSCEIVER
SS-62
PRODUCT SPECIFIC FLASH ADAPTER

Figure 7 Flash concept with SS-62 and CA-89DS

Type	Description
Product specific tools	
FS-70	Flash adapter
Other tools	
CU-4	Control unit
FLS-5	Flash device
SS-62	Flash adapter base
	PC with Phoenix service software
Cables	
CA-89DS	Cable
PCS-1	Power cable
	USB cable

Flash concept with FPS-10, SS-62 and JBT-9

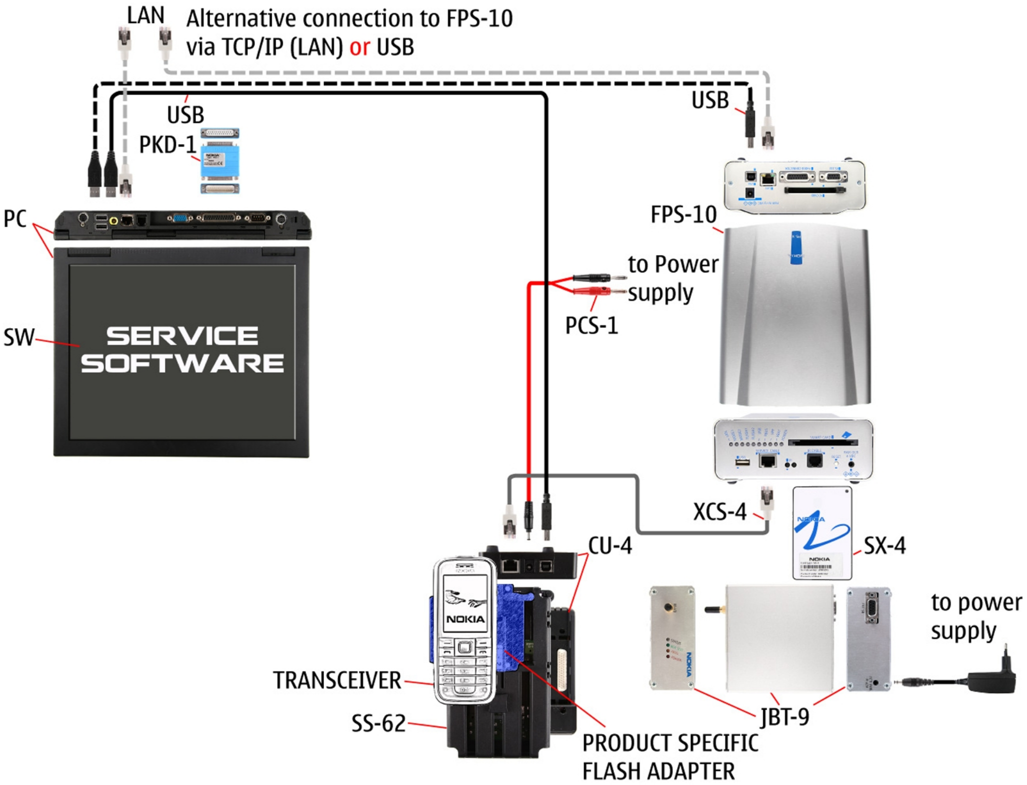

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
USB
PKD-1
PC
SW
SERVICE SOFTWARE
FPS-10
to Power supply
PCS-1
XCS-4
CU-4
SX-4
to power supply
TRANSCEIVER
SS-62
JBT-9
PRODUCT SPECIFIC FLASH ADAPTER

Figure 8 Flash concept with FPS-10, SS-62 and JBT-9

Type	Description
Product specific tools	
FS-70	Flash adapter
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
JBT-9	Bluetooth test and interface box
SX-4	Smart card
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
PCS-1	Power cable
	USB cable

Flash concept with FPS-10, SS-62 and SB-7

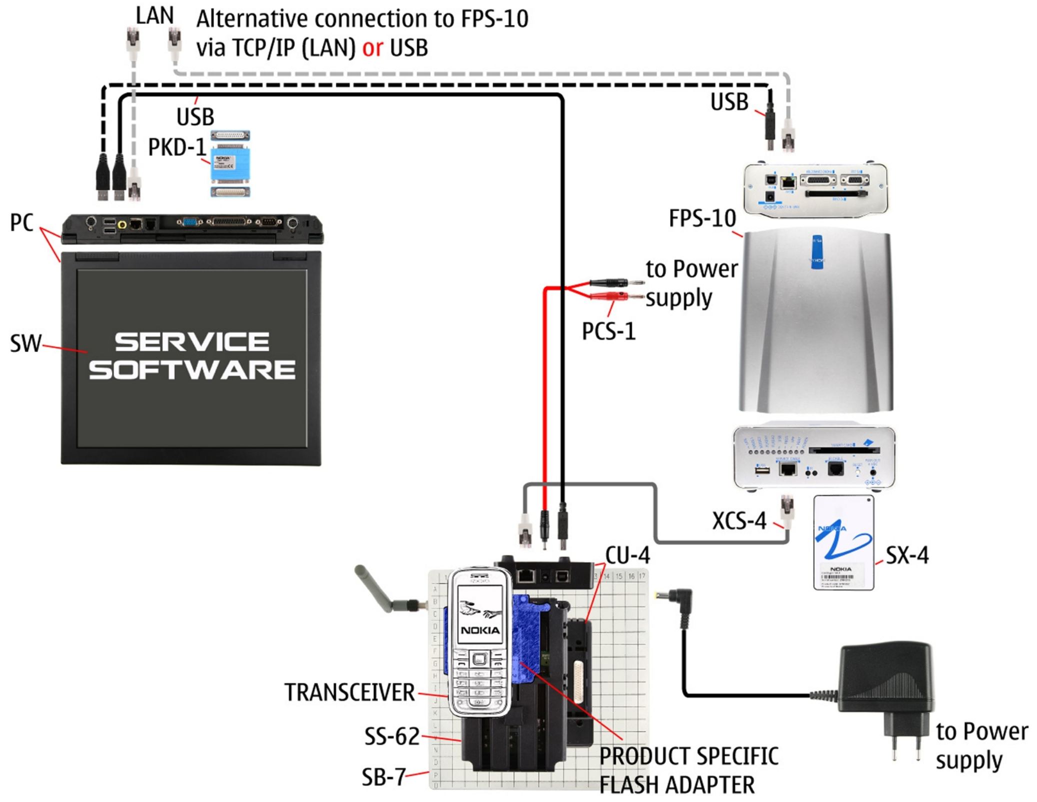

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XCS-4
SX-4
CU-4
TRANSCEIVER
SS-62
SB-7
PRODUCT SPECIFIC
FLASH ADAPTER
to Power
supply

Figure 9 Flash concept with FPS-10, SB-7 and JBT-9

Type	Description
Product specific tools	
FS-70	Flash adapter
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SB-7	WLAN test box
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
PCS-1	Power cable
	USB cable

Module jig service concept

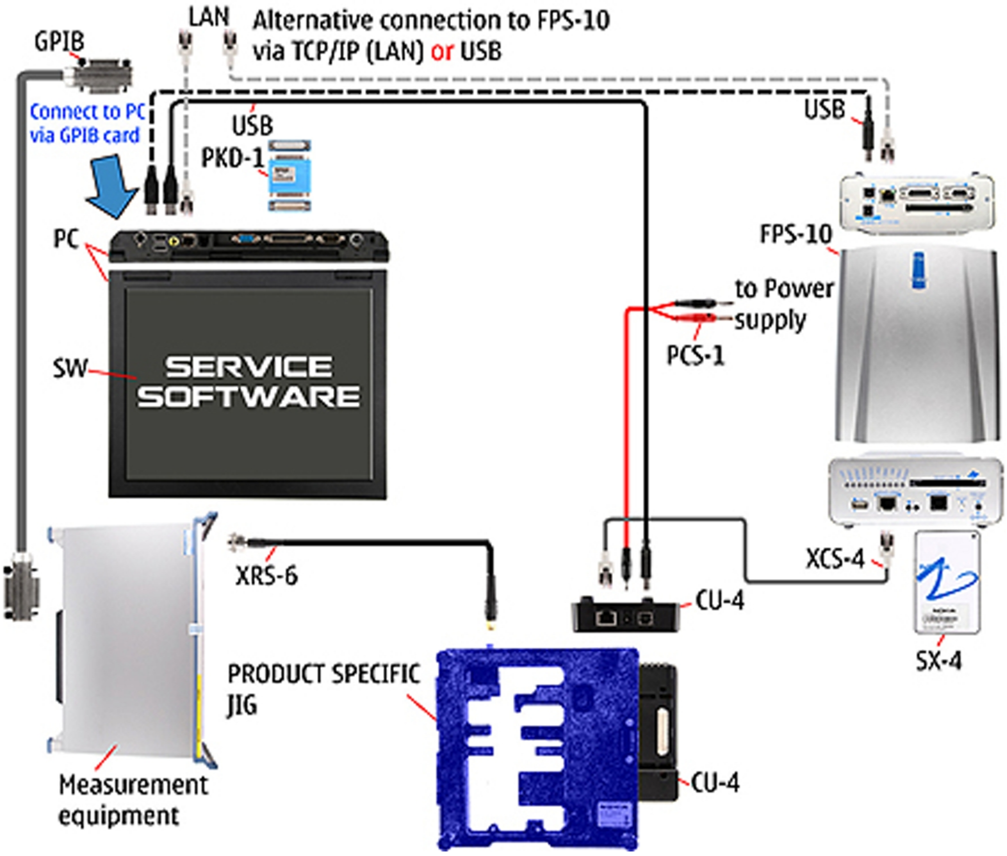

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC
JIG
CU-4
Measurement
equipment

Figure 10 Module jig service concept

Type	Description
Phone specific devices	
MJ-102	Module jig
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SX-4	Smart card
	PC with VPOS and Phoenix service software
	Measurement equipment
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRF-1	RF cable
	USB cable

Type	Description
	GPIB control cable

Module jig service concept with JBT-9 and smart card reader

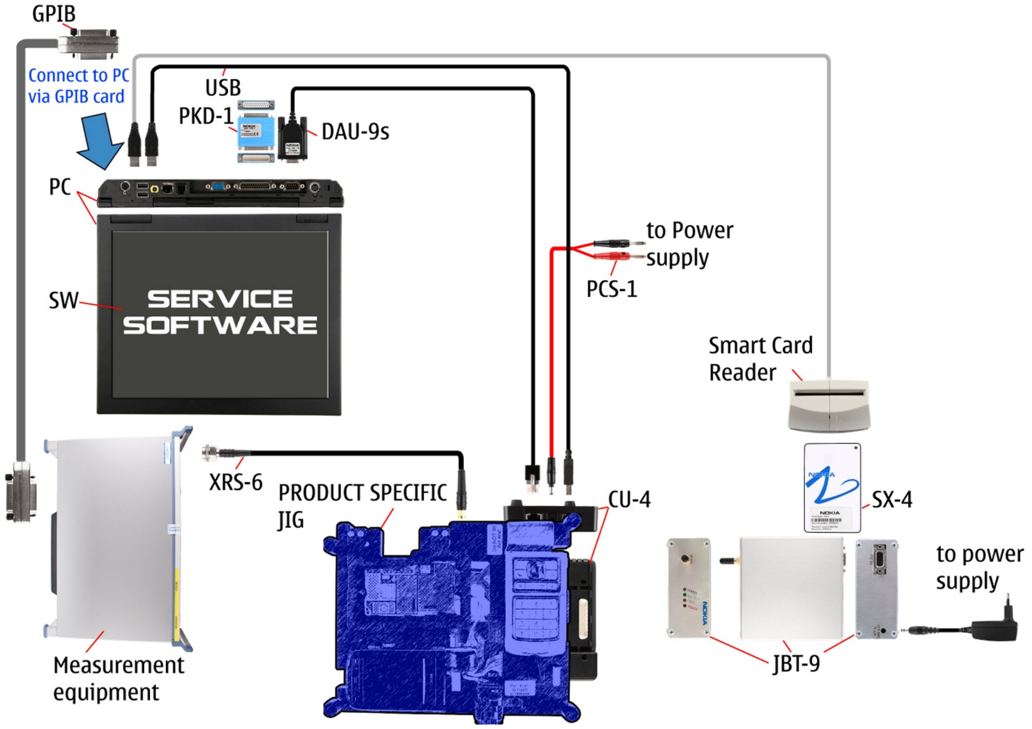

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
PRODUCT SPECIFIC JIG
CU-4
SX-4
to power supply
Measurement equipment
JBT-9

Figure 11 Service concept with JBT-9 and smart card reader

Type	Description
Product specific tools	
MJ-102	Module jig
Other tools	
CU-4	Control unit
JBT-9	Bluetooth test and interface box
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	PC with Phoenix service software
	Smart card reader
Cables	
DAU-9S	MBUS cable
PCS-1	DC power cable
XRS-6	RF cable
	GPIB control cable

Type	Description
	USB cable

Module jig service concept with JBT-9

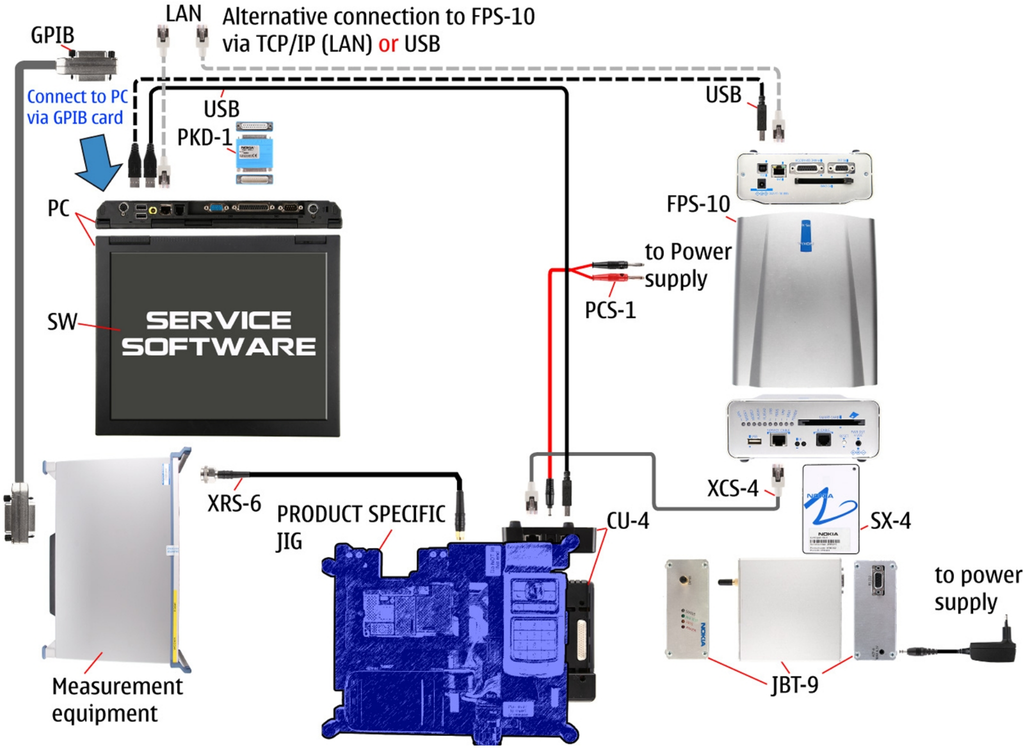

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
Connect to PC
via GPIB card
USB
PKD-1
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XCS-4
SX-4
XRS-6
PRODUCT SPECIFIC
JIG
CU-4
to power
supply
Measurement
equipment
JBT-9

Figure 12 Module jig service concept with JBT-9

Type	Description
Product specific tools	
MJ-102	Module jig
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
JBT-9	Bluetooth test and interface box
PKD-1	SW security device
SX-4	Smart card
	Measurement equipment
	PC with Phoenix service software
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRS-6	RF cable

Type	Description
	GPIB control cable
	USB cable

RF testing concept with RF coupler

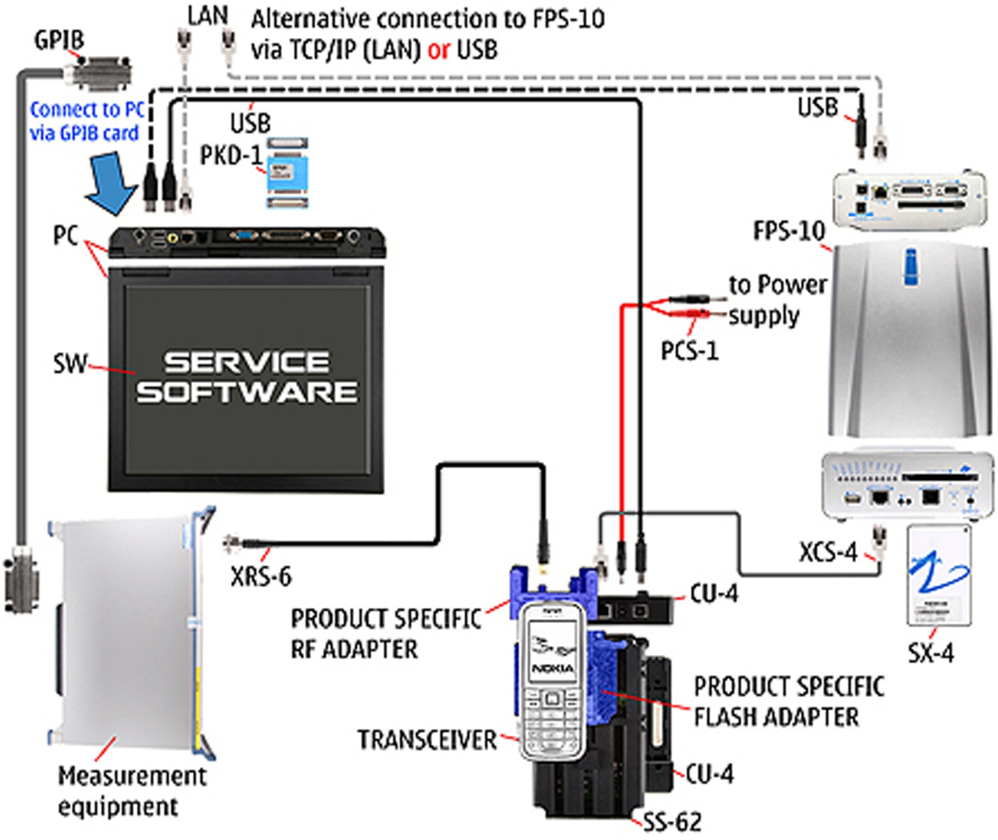

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
CU-4
PRODUCT SPECIFIC
RF ADAPTER
SX-4
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
CU-4
SS-62
Measurement
equipment

Figure 13 RF testing concept with RF coupler

Type	Description
Product specific devices	
FS-70	Flash adapter
SA-106	RF coupler
Other devices	
CU-4	Control unit
SX-4	Smart card
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
	Measurement equipment
	PC with Phoenix service software
Cables	

Type	Description
PCS-1	Power cable
XCS-4	Modular cable
XRS-6	RF cable
	GPIB control cable
	USB cable

Service concept for RF testing and RF/BB tuning

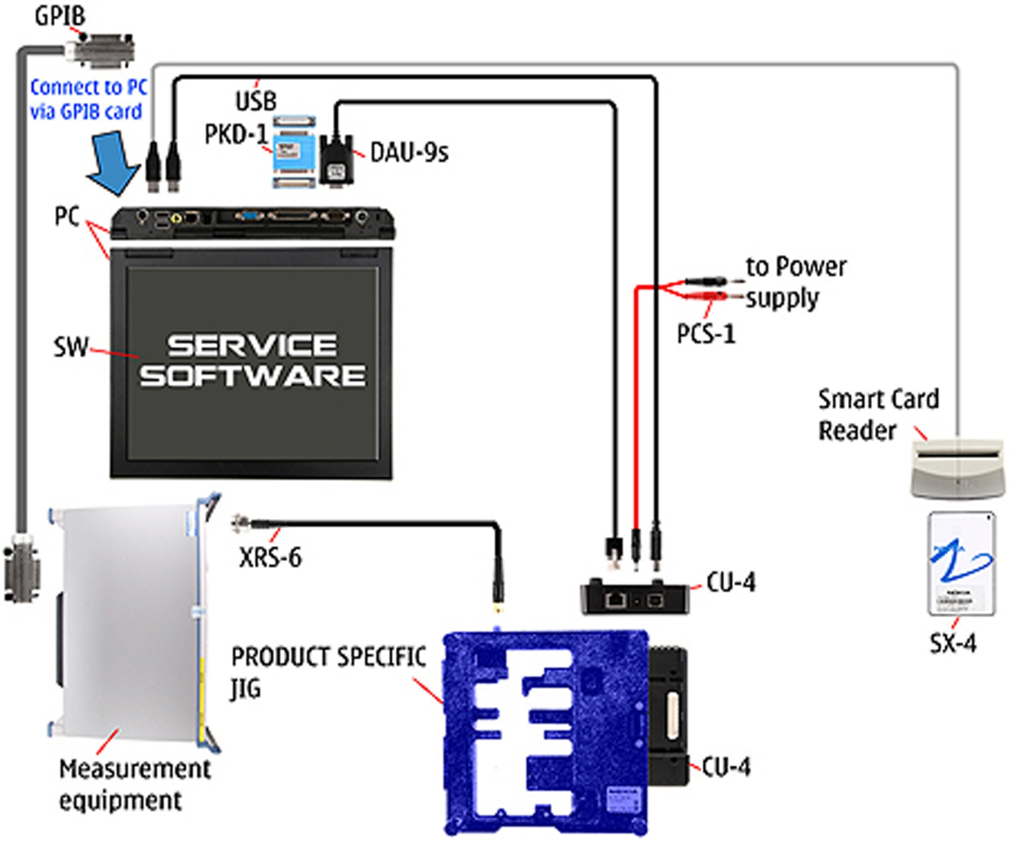

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
CU-4
SX-4
PRODUCT SPECIFIC JIG
CU-4
Measurement equipment

Figure 14 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific devices	
MJ-102	Module jig
Other devices	
CU-4	Control unit
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	Smart card reader

Type	Description
	PC with Phoenix service software
Cables	
DAU-9s	MBUS cable
PCS-1	DC power cable
XRS-6	RF cable
	GPIB control cable
	USB cable

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3 — BB Troubleshooting and Tuning Guide

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Table of Contents

Dead or jammed device troubleshooting 3–5
General power checking troubleshooting - CMT 3–6
General power checking troubleshooting - APE 3–7
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Charging troubleshooting 3–11
Battery current measuring fault troubleshooting 3–12
Flash programming fault troubleshooting 3–13
Combo memory fault troubleshooting 3–16
Application processor memory troubleshooting 3–17
APE temperature sensor troubleshooting 3–18
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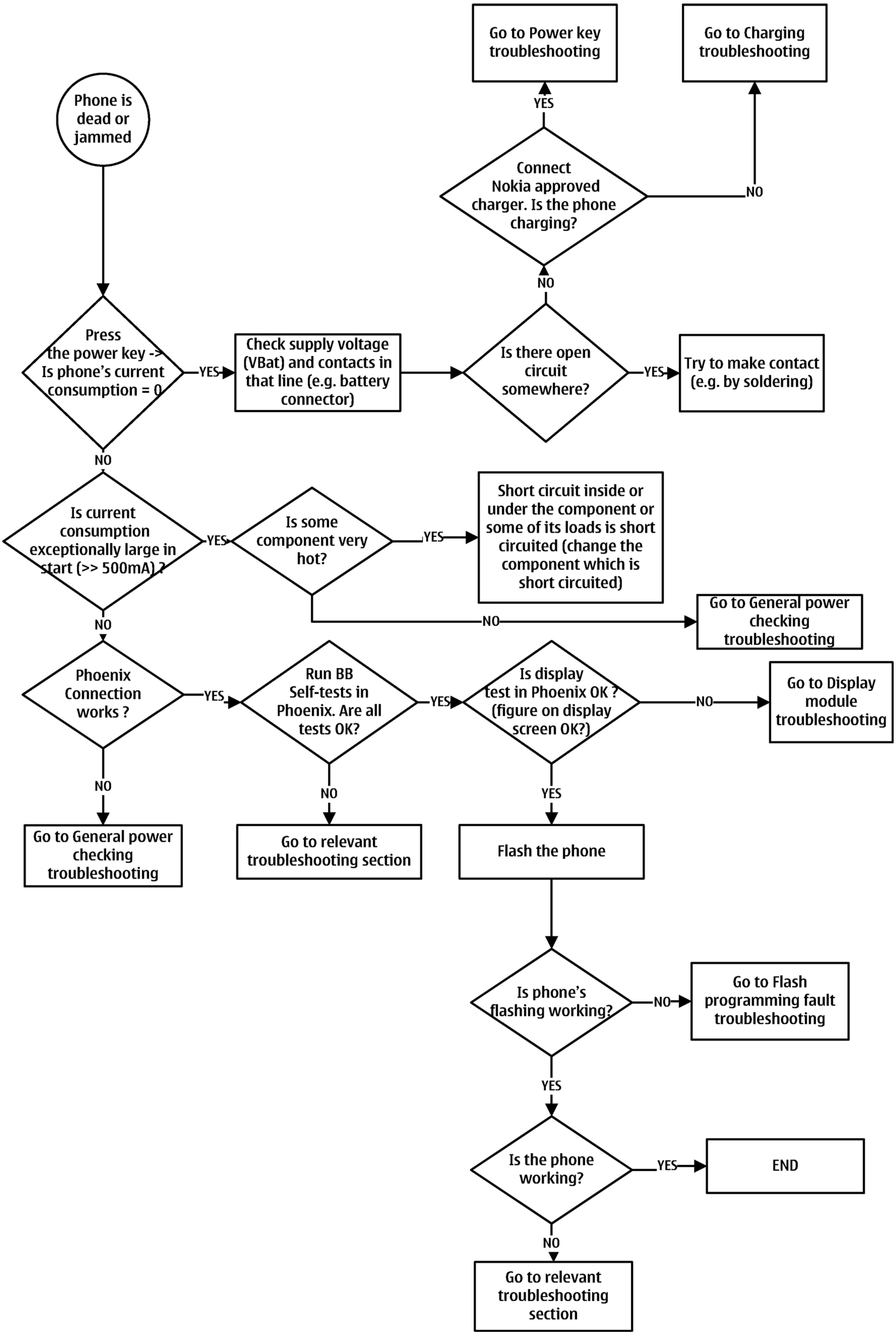
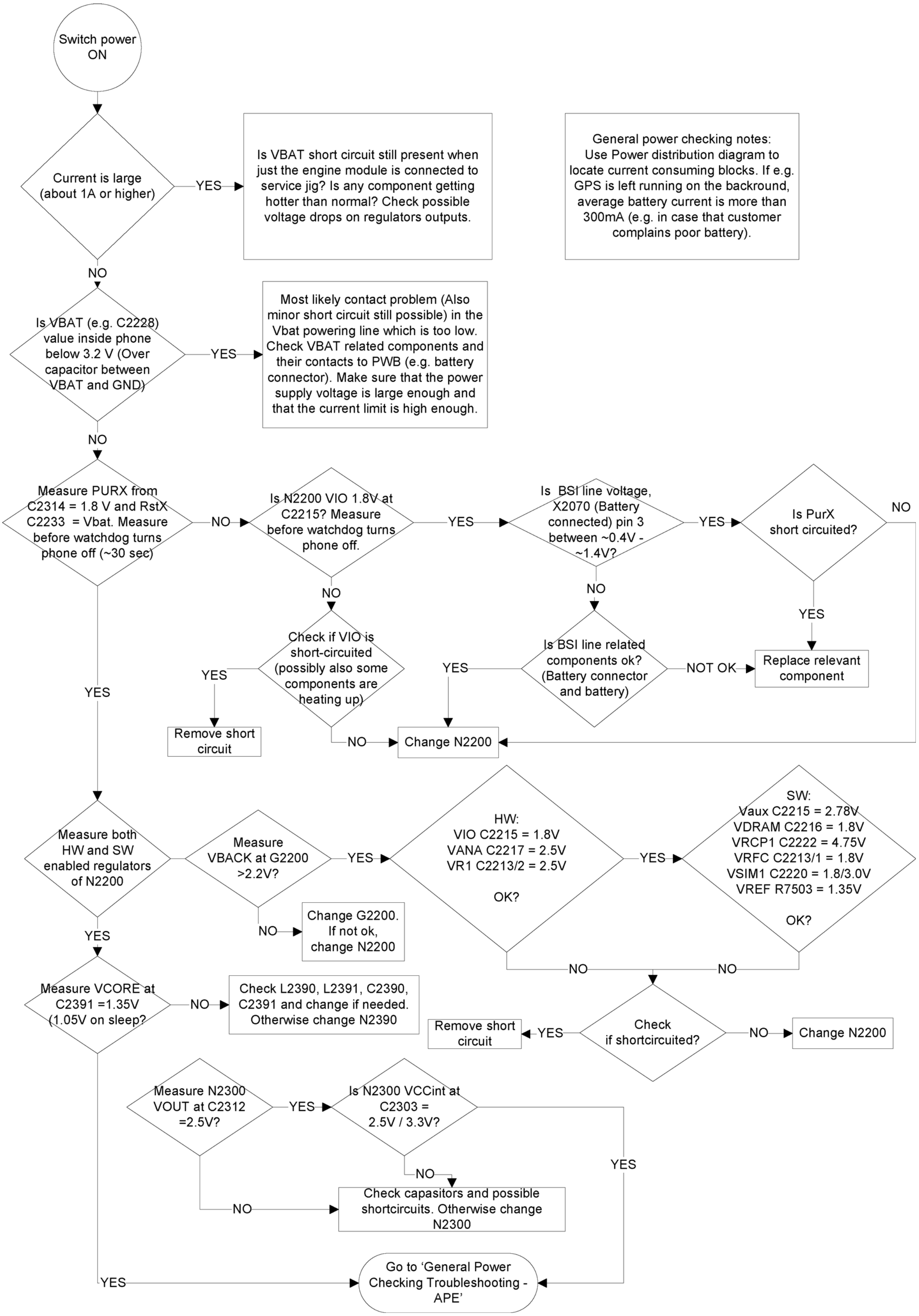
Dead or jammed device troubleshooting

Troubleshooting flow


Go to Power key troubleshooting
Go to Charging troubleshooting
Phone is dead or jammed
YES
Connect Nokia approved charger. Is the phone charging?
NO
NO
Press the power key -> Is phone's current consumption = 0
YES
Check supply voltage (VBat) and contacts in that line (e.g. battery connector)
Is there open circuit somewhere?
YES
Try to make contact (e.g. by soldering)
NO
Is current consumption exceptionally large in start (>> 500mA) ?
YES
Is some component very hot?
YES
Short circuit inside or under the component or some of its loads is short circuited (change the component which is short circuited)
NO
Go to General power checking troubleshooting
NO
Phoenix Connection works ?
YES
Run BB Self-tests in Phoenix. Are all tests OK?
YES
Is display test in Phoenix OK ? (figure on display screen OK?)
NO
Go to Display module troubleshooting
NO
NO
YES
Go to General power checking troubleshooting
Go to relevant troubleshooting section
Flash the phone
Is phone's flashing working?
NO
Go to Flash programming fault troubleshooting
YES
Is the phone working?
YES
END
NO
Go to relevant troubleshooting section

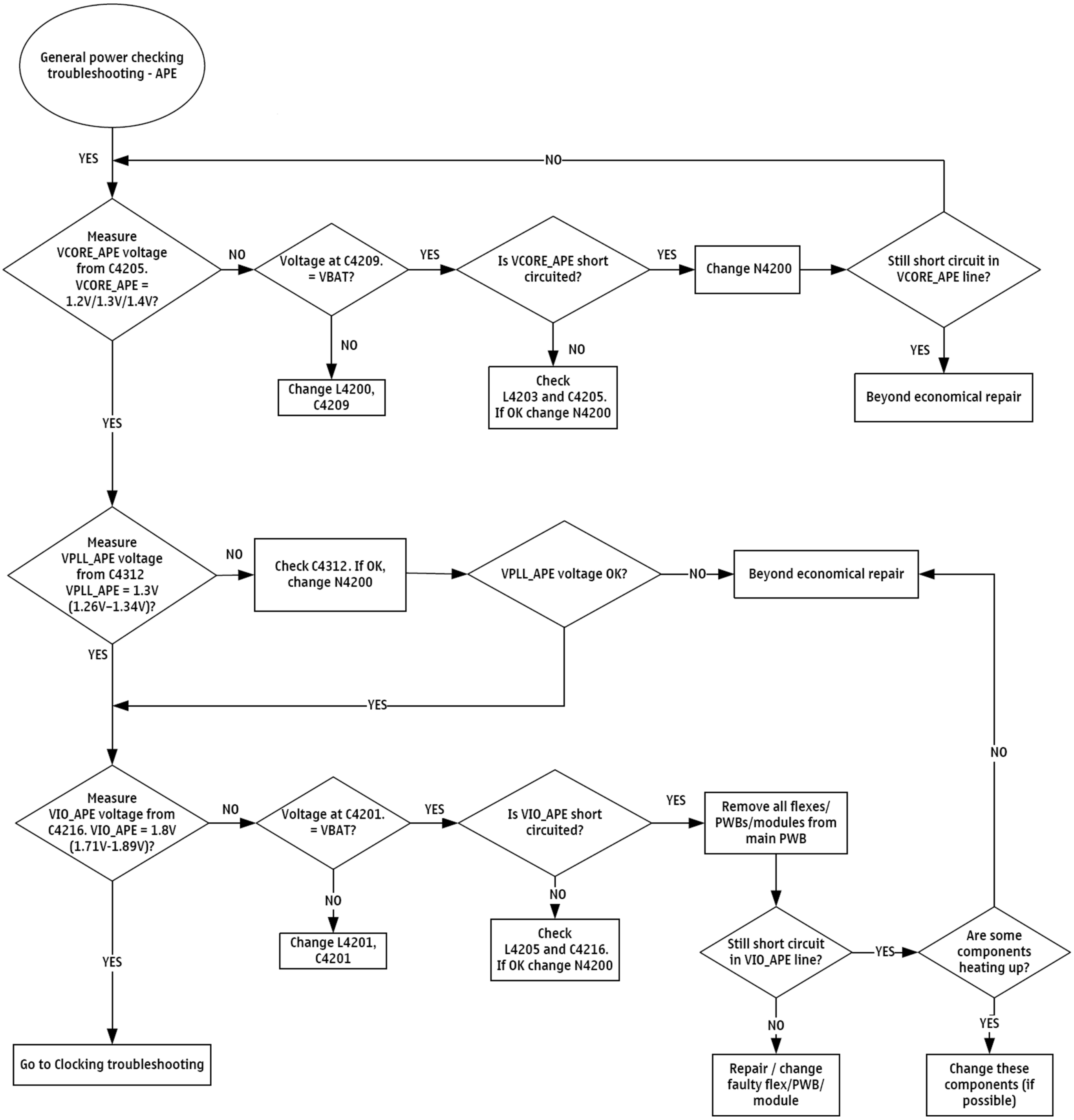
General power checking troubleshooting - CMT

Troubleshooting flow


Switch power ON
Current is large (about 1A or higher)
YES
Is VBAT short circuit still present when just the engine module is connected to service jig? Is any component getting hotter than normal? Check possible voltage drops on regulators outputs.
General power checking notes: Use Power distribution diagram to locate current consuming blocks. If e.g. GPS is left running on the backround, average battery current is more than 300mA (e.g. in case that customer complains poor battery).
NO
Is VBAT (e.g. C2228) value inside phone below 3.2 V (Over capacitor between VBAT and GND)
YES
Most likely contact problem (Also minor short circuit still possible) in the Vbat powering line which is too low. Check VBAT related components and their contacts to PWB (e.g. battery connector). Make sure that the power supply voltage is large enough and that the current limit is high enough.
NO
Measure PURX from C2314 = 1.8 V and RstX C2233 = Vbat. Measure before watchdog turns phone off (~30 sec)
NO
Is N2200 VIO 1.8V at C2215? Measure before watchdog turns phone off.
YES
Is BSI line voltage, X2070 (Battery connected) pin 3 between ~0.4V - ~1.4V?
YES
Is PurX short circuited?
NO
YES
Replace relevant component
NO
Is BSI line related components ok? (Battery connector and battery)
NOT OK
YES
NO
Check if VIO is short-circuited (possibly also some components are heating up)
YES
Remove short circuit
NO
Change N2200
YES
Measure both HW and SW enabled regulators of N2200
Measure VBACK at G2200 >2.2V?
YES
NO
Change G2200. If not ok, change N2200
HW: VIO C2215 = 1.8V VANA C2217 = 2.5V VR1 C2213/2 = 2.5V OK?
YES
SW: Vaux C2215 = 2.78V VDRAM C2216 = 1.8V VRCP1 C2222 = 4.75V VRFC C2213/1 = 1.8V VSIM1 C2220 = 1.8/3.0V VREF R7503 = 1.35V OK?
NO
NO
YES
Measure VCORE at C2391 =1.35V (1.05V on sleep?
NO
Check L2390, L2391, C2390, C2391 and change if needed. Otherwise change N2390
Check if shortcircuited?
YES
Remove short circuit
NO
Change N2200
Measure N2300 VOUT at C2312 =2.5V?
YES
Is N2300 VCCint at C2303 = 2.5V / 3.3V?
NO
Check capasitors and possible shortcircuits. Otherwise change N2300
NO
YES
YES
Go to 'General Power Checking Troubleshooting - APE'

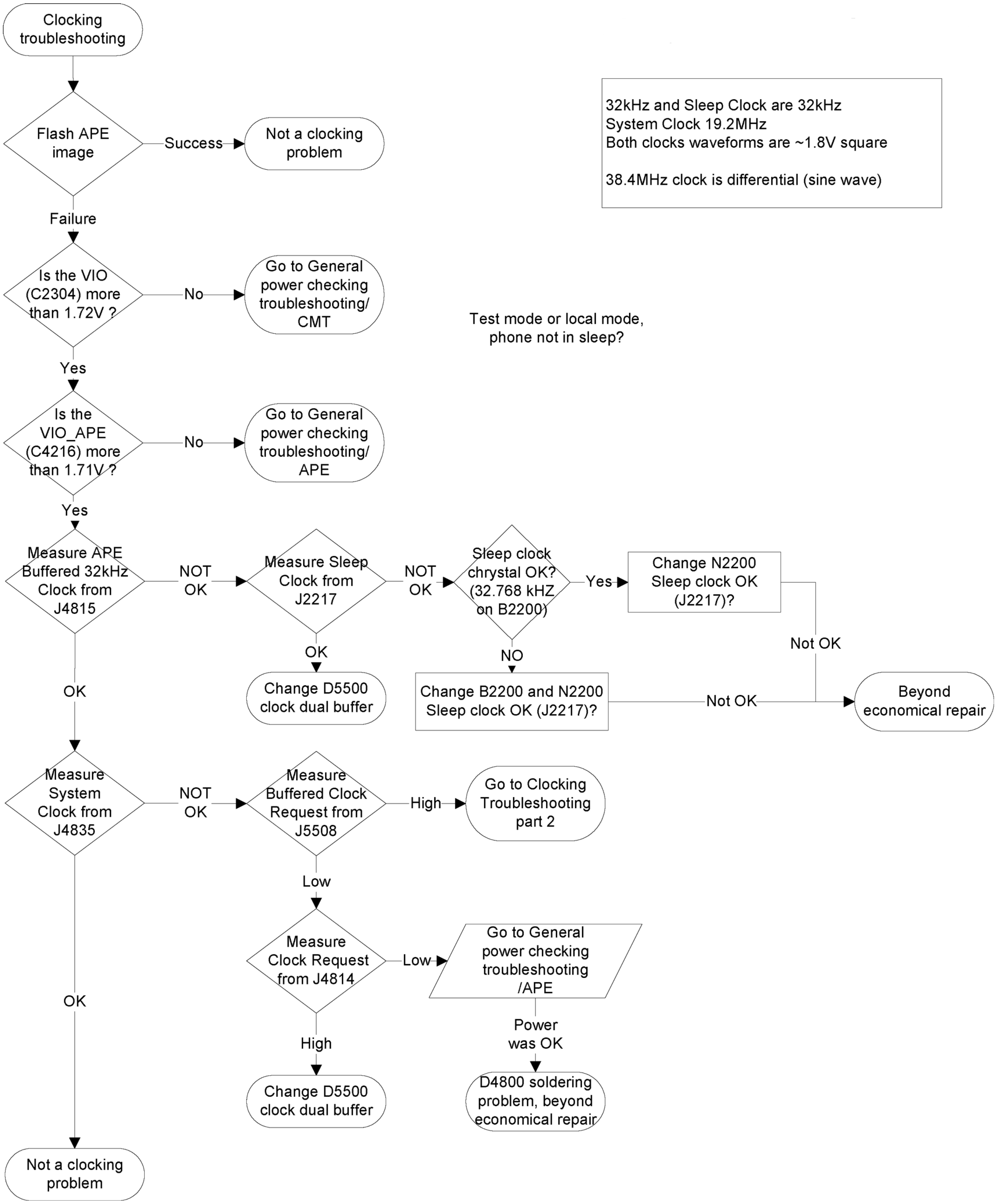
General power checking troubleshooting - APE

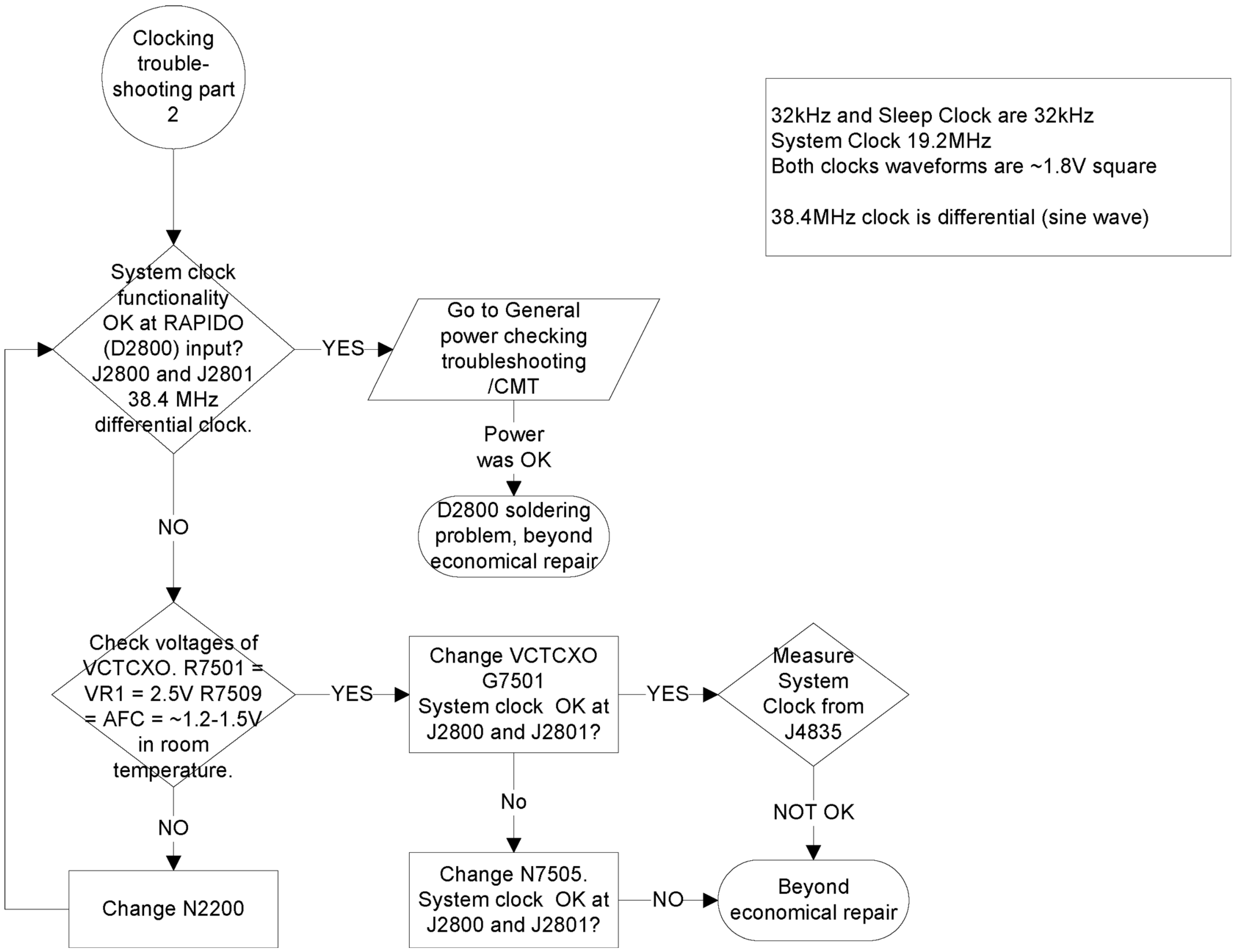
Troubleshooting flow


General power checking troubleshooting - APE
YES
NO
Measure VCORE_APE voltage from C4205. VCORE_APE = 1.2V/1.3V/1.4V?
NO
Voltage at C4209. = VBAT?
YES
Is VCORE_APE short circuited?
YES
Change N4200
Still short circuit in VCORE_APE line?
NO
Change L4200, C4209
NO
Check L4203 and C4205. If OK change N4200
YES
Beyond economical repair
YES
Measure VPLL_APE voltage from C4312 VPLL_APE = 1.3V (1.26V–1.34V)?
NO
Check C4312. If OK, change N4200
VPLL_APE voltage OK?
NO
Beyond economical repair
YES
YES
NO
Measure VIO_APE voltage from C4216. VIO_APE = 1.8V (1.71V-1.89V)?
NO
Voltage at C4201. = VBAT?
YES
Is VIO_APE short circuited?
YES
Remove all flexes/ PWBs/modules from main PWB
NO
Change L4201, C4201
NO
Check L4205 and C4216. If OK change N4200
Still short circuit in VIO_APE line?
YES
Are some components heating up?
YES
Go to Clocking troubleshooting
NO
Repair / change faulty flex/PWB/ module
YES
Change these components (if possible)

Clocking troubleshooting

Troubleshooting flow


Clocking troubleshooting
Flash APE image
Success
Not a clocking problem
Failure
Is the VIO (C2304) more than 1.72V ?
No
Go to General power checking troubleshooting/ CMT
Yes
Is the VIO_APE (C4216) more than 1.71V ?
No
Go to General power checking troubleshooting/ APE
Yes
Measure APE Buffered 32kHz Clock from J4815
NOT OK
Measure Sleep Clock from J2217
NOT OK
Sleep clock chrystal OK? (32.768 kHZ on B2200)
Yes
Change N2200 Sleep clock OK (J2217)?
Not OK
OK
Change D5500 clock dual buffer
NO
Change B2200 and N2200 Sleep clock OK (J2217)?
Not OK
Beyond economical repair
OK
Measure System Clock from J4835
NOT OK
Measure Buffered Clock Request from J5508
High
Go to Clocking Troubleshooting part 2
Low
Measure Clock Request from J4814
Low
Go to General power checking troubleshooting /APE
Power was OK
D4800 soldering problem, beyond economical repair
High
Change D5500 clock dual buffer
OK
Not a clocking problem
32kHz and Sleep Clock are 32kHz
System Clock 19.2MHz
Both clocks waveforms are ~1.8V square
38.4MHz clock is differential (sine wave)
Test mode or local mode, phone not in sleep?

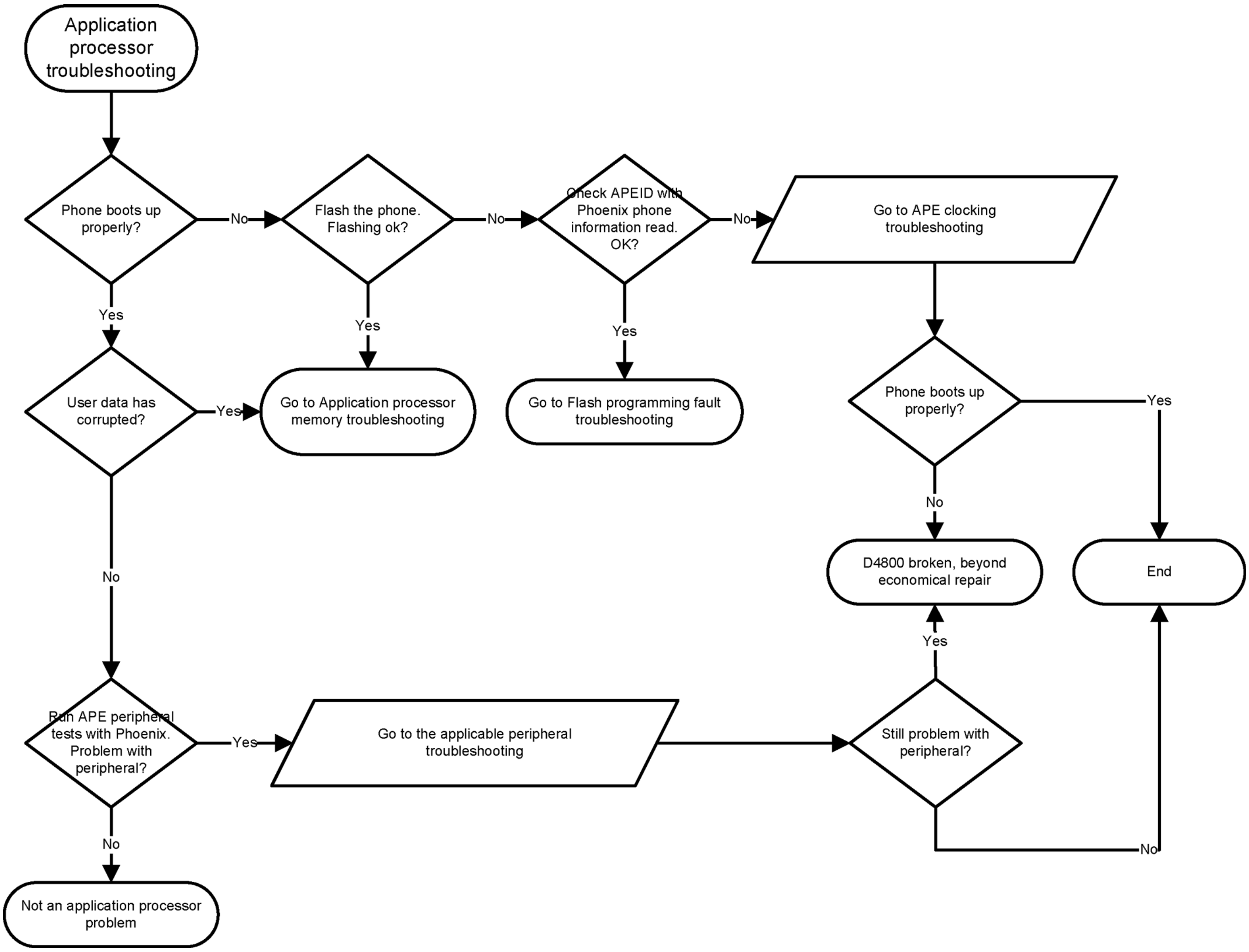

Clocking trouble-shooting part 2
System clock functionality OK at RAPIDO (D2800) input? J2800 and J2801 38.4 MHz differential clock.
YES
Go to General power checking troubleshooting /CMT
Power was OK
D2800 soldering problem, beyond economical repair
NO
Check voltages of VCTCXO. R7501 = VR1 = 2.5V R7509 = AFC = ~1.2-1.5V in room temperature.
YES
Change VCTCXO G7501 System clock OK at J2800 and J2801?
YES
Measure System Clock from J4835
NOT OK
Beyond economical repair
No
Change N7505. System clock OK at J2800 and J2801?
NO
NO
Change N2200

32kHz and Sleep Clock are 32kHz
System Clock 19.2MHz
Both clocks waveforms are ~1.8V square

38.4MHz clock is differential (sine wave)

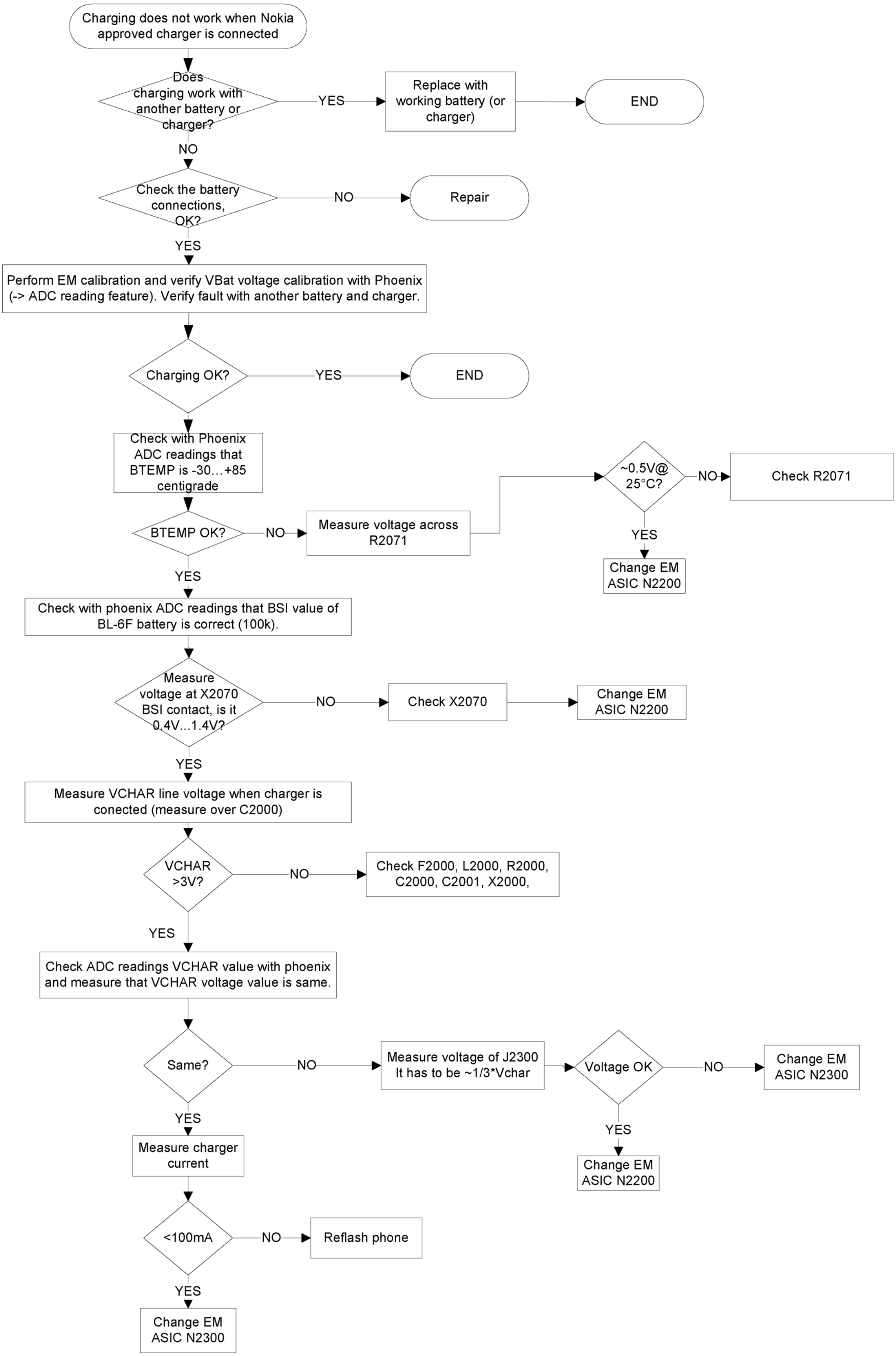
Application processor troubleshooting

Troubleshooting flow


Application processor troubleshooting
Phone boots up properly?
No
Flash the phone. Flashing ok?
No
Check APEID with Phoenix phone information read. OK?
No
Go to APE clocking troubleshooting
Yes
Yes
Yes
User data has corrupted?
Yes
Go to Application processor memory troubleshooting
Go to Flash programming fault troubleshooting
Phone boots up properly?
Yes
No
D4800 broken, beyond economical repair
End
No
Yes
Run APE peripheral tests with Phoenix. Problem with peripheral?
Yes
Go to the applicable peripheral troubleshooting
Still problem with peripheral?
No
No
Not an application processor problem

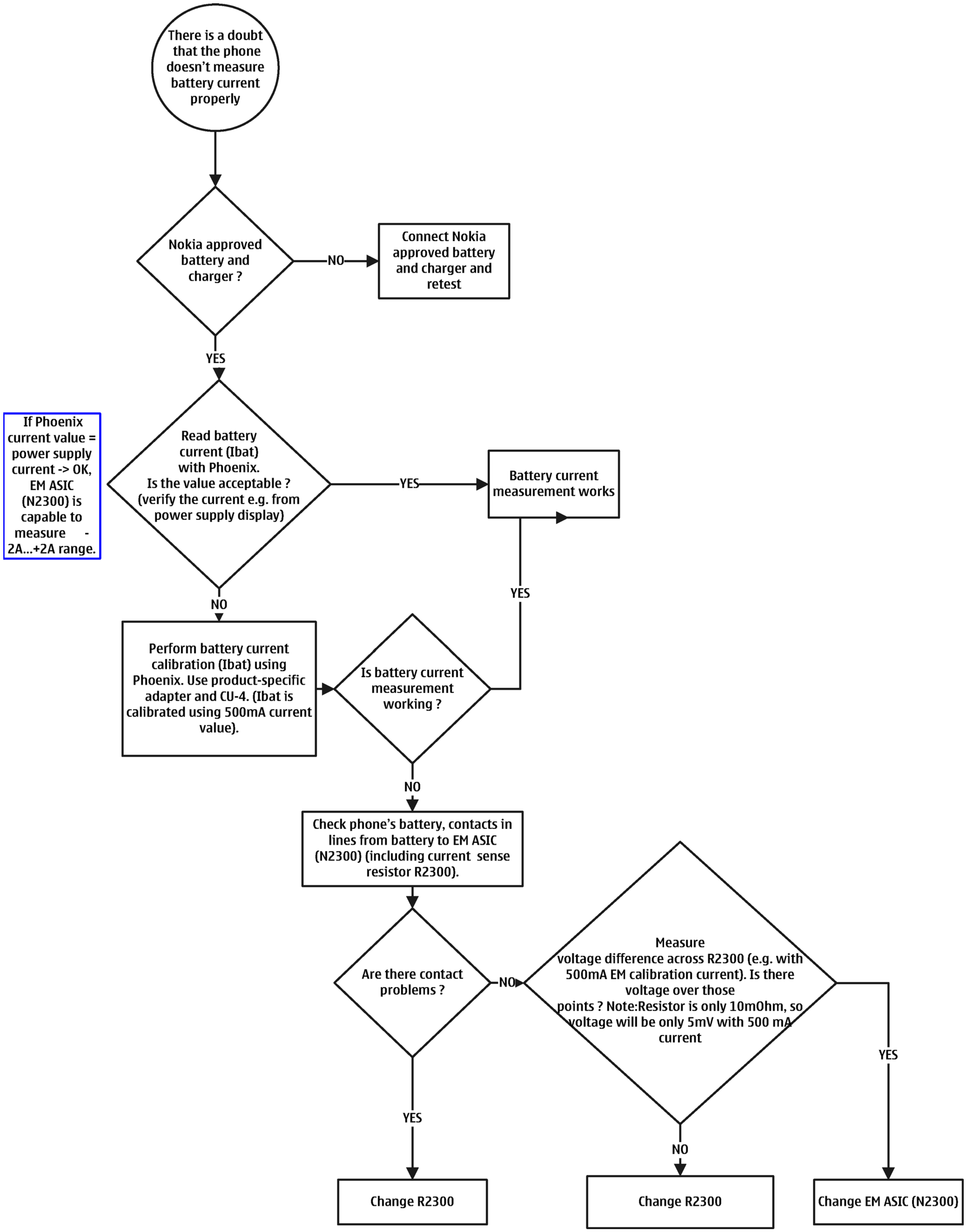
Charging troubleshooting

Troubleshooting flow


Charging does not work when Nokia approved charger is connected
Does charging work with another battery or charger?
YES
Replace with working battery (or charger)
END
NO
Check the battery connections, OK?
NO
Repair
YES
Perform EM calibration and verify VBat voltage calibration with Phoenix (-> ADC reading feature). Verify fault with another battery and charger.
Charging OK?
YES
END
Check with Phoenix ADC readings that BTEMP is -30…+85 centigrade
BTEMP OK?
NO
Measure voltage across R2071
~0.5V@ 25°C?
NO
Check R2071
YES
Change EM ASIC N2200
YES
Check with phoenix ADC readings that BSI value of BL-6F battery is correct (100k).
Measure voltage at X2070 BSI contact, is it 0.4V...1.4V?
NO
Check X2070
Change EM ASIC N2200
YES
Measure VCHAR line voltage when charger is conected (measure over C2000)
VCHAR >3V?
NO
Check F2000, L2000, R2000, C2000, C2001, X2000,
YES
Check ADC readings VCHAR value with phoenix and measure that VCHAR voltage value is same.
Same?
NO
Measure voltage of J2300 It has to be ~1/3*Vchar
Voltage OK
NO
Change EM ASIC N2300
YES
Change EM ASIC N2200
YES
Measure charger current
<100mA
NO
Reflash phone
YES
Change EM ASIC N2300

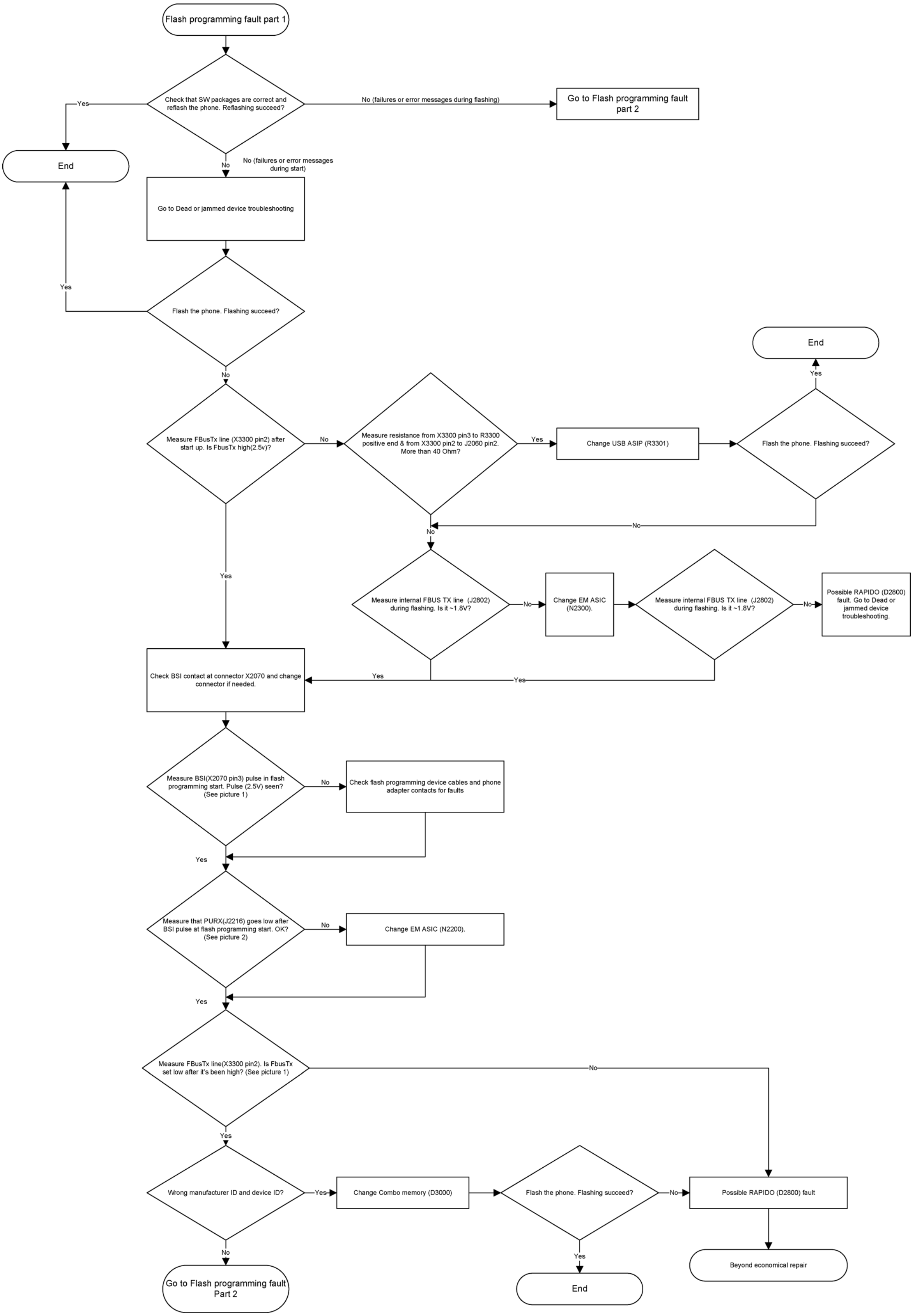
Battery current measuring fault troubleshooting

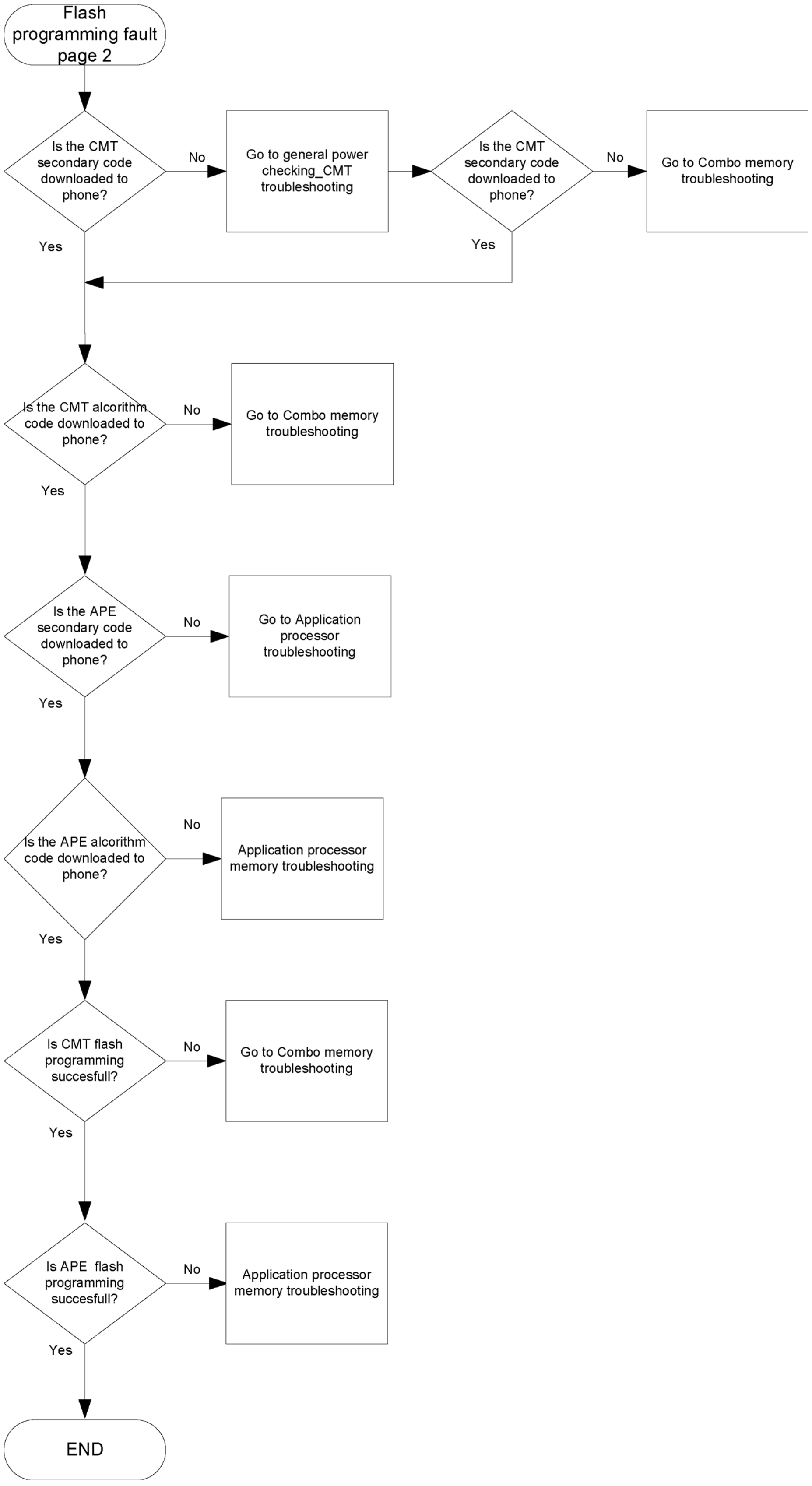
Troubleshooting flow

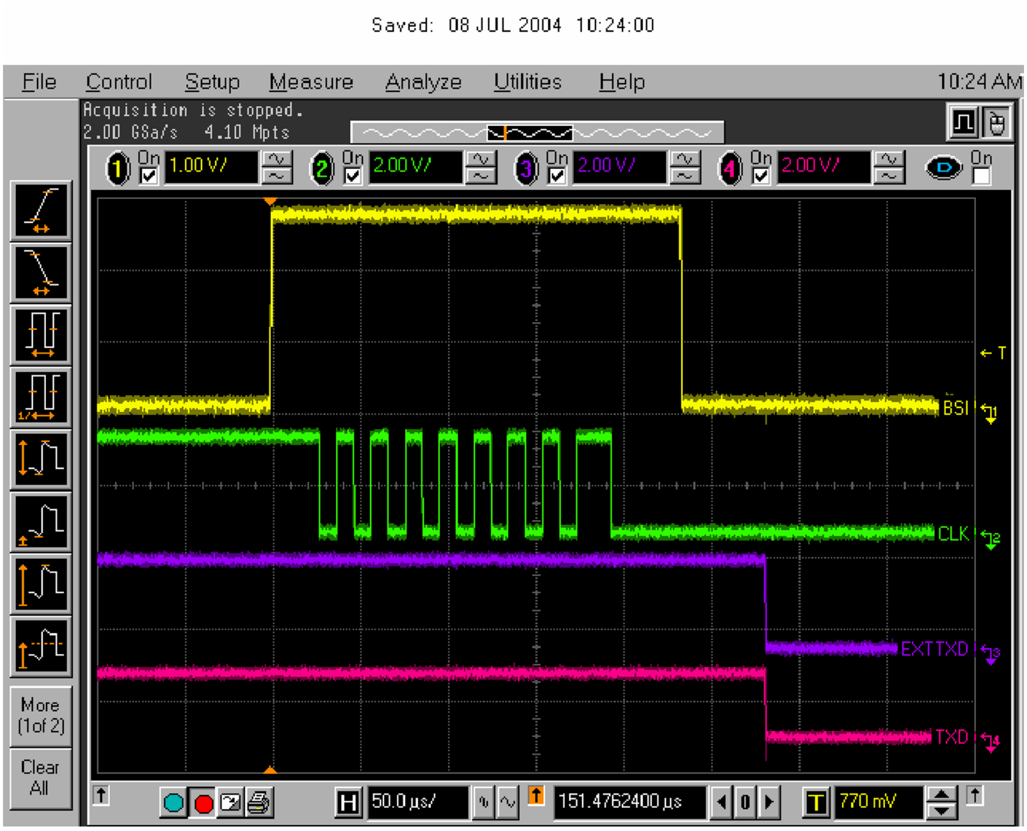

There is a doubt that the phone doesn't measure battery current properly
Nokia approved battery and charger ?
NO
Connect Nokia approved battery and charger and retest
YES
If Phoenix current value = power supply current -> OK, EM ASIC (N2300) is capable to measure -2A...+2A range.
Read battery current (Ibat) with Phoenix. Is the value acceptable ? (verify the current e.g. from power supply display)
YES
Battery current measurement works
NO
Perform battery current calibration (Ibat) using Phoenix. Use product-specific adapter and CU-4. (Ibat is calibrated using 500mA current value).
Is battery current measurement working ?
YES
NO
Check phone's battery, contacts in lines from battery to EM ASIC (N2300) (including current sense resistor R2300).
Are there contact problems ?
NO
Measure voltage difference across R2300 (e.g. with 500mA EM calibration current). Is there voltage over those points ? Note:Resistor is only 10mOhm, so voltage will be only 5mV with 500 mA current
YES
YES
NO
Change R2300
Change R2300
Change EM ASIC (N2300)

Flash programming fault troubleshooting

Troubleshooting flow


Flash programming fault part 1
Check that SW packages are correct and reflash the phone. Reflashing succeed?
Yes
End
No (failures or error messages during flashing)
Go to Flash programming fault part 2
No
No (failures or error messages during start)
Go to Dead or jammed device troubleshooting
Flash the phone. Flashing succeed?
Yes
No
Measure FBusTx line (X3300 pin2) after start up. Is FbusTx high(2.5v)?
No
Measure resistance from X3300 pin3 to R3300 positive end & from X3300 pin2 to J2060 pin2. More than 40 Ohm?
Yes
Change USB ASIP (R3301)
Flash the phone. Flashing succeed?
Yes
End
No
No
Yes
Measure internal FBUS TX line (J2802) during flashing. Is it ~1.8V?
No
Change EM ASIC (N2300).
Measure internal FBUS TX line (J2802) during flashing. Is it ~1.8V?
No
Possible RAPIDO (D2800) fault. Go to Dead or jammed device troubleshooting.
Yes
Yes
Check BSI contact at connector X2070 and change connector if needed.
Measure BSI(X2070 pin3) pulse in flash programming start. Pulse (2.5V) seen? (See picture 1)
No
Check flash programming device cables and phone adapter contacts for faults
Yes
Measure that PURX(J2216) goes low after BSI pulse at flash programming start. OK? (See picture 2)
No
Change EM ASIC (N2200).
Yes
Measure FBusTx line(X3300 pin2). Is FbusTx set low after it's been high? (See picture 1)
No
Yes
Wrong manufacturer ID and device ID?
Yes
Change Combo memory (D3000)
Flash the phone. Flashing succeed?
No
Possible RAPIDO (D2800) fault
Beyond economical repair
Yes
End
No
Go to Flash programming fault Part 2


Flash programming fault page 2
Is the CMT secondary code downloaded to phone?
No
Go to general power checking_CMT troubleshooting
Is the CMT secondary code downloaded to phone?
No
Go to Combo memory troubleshooting
Yes
Yes
Is the CMT alcorithm code downloaded to phone?
No
Go to Combo memory troubleshooting
Yes
Is the APE secondary code downloaded to phone?
No
Go to Application processor troubleshooting
Yes
Is the APE alcorithm code downloaded to phone?
No
Application processor memory troubleshooting
Yes
Is CMT flash programming succesfull?
No
Go to Combo memory troubleshooting
Yes
Is APE flash programming succesfull?
No
Application processor memory troubleshooting
Yes
END



Saved: 08 JUL 2004 10:24:00

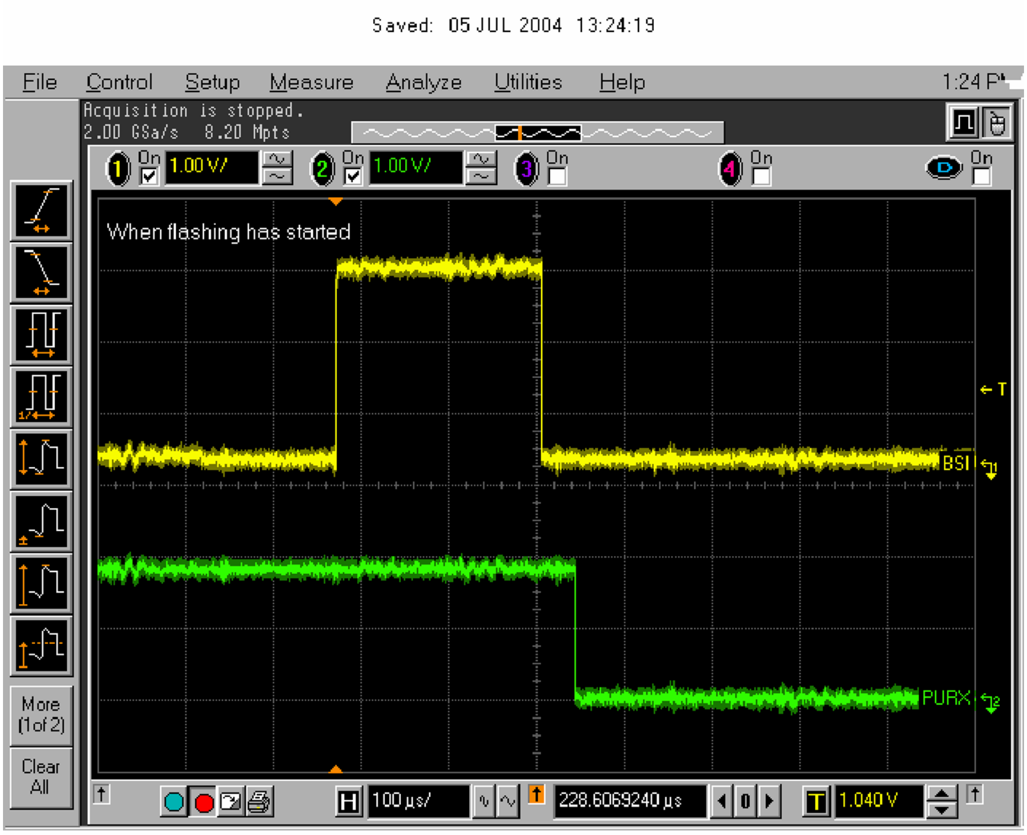
Acquisition is stopped.
2.00 GSa/s 4.10 Mpts

1 On 1.00 V/ 2 On 2.00 V/ 3 On 2.00 V/ 4 On 2.00 V/

H 50.0 µs/ 151.4762400 µs T 770 mV

File
Control
Setup
Measure
Analyze
Utilities
Help
10:24 AM
BSI
CLK
EXTTXD
TXD
T
More (1of 2)
Clear All

Figure 15 Flashing pic 1. Take single triggered measurement for the rise of the BSI signal



Saved: 05 JUL 2004 13:24:19

Acquisition is stopped.
2.00 GSa/s 8.20 Mpts

1 On 1.00 V/ 2 On 1.00 V/ 3 On 4 On

H 100 µs/ 228.6069240 µs T 1.040 V

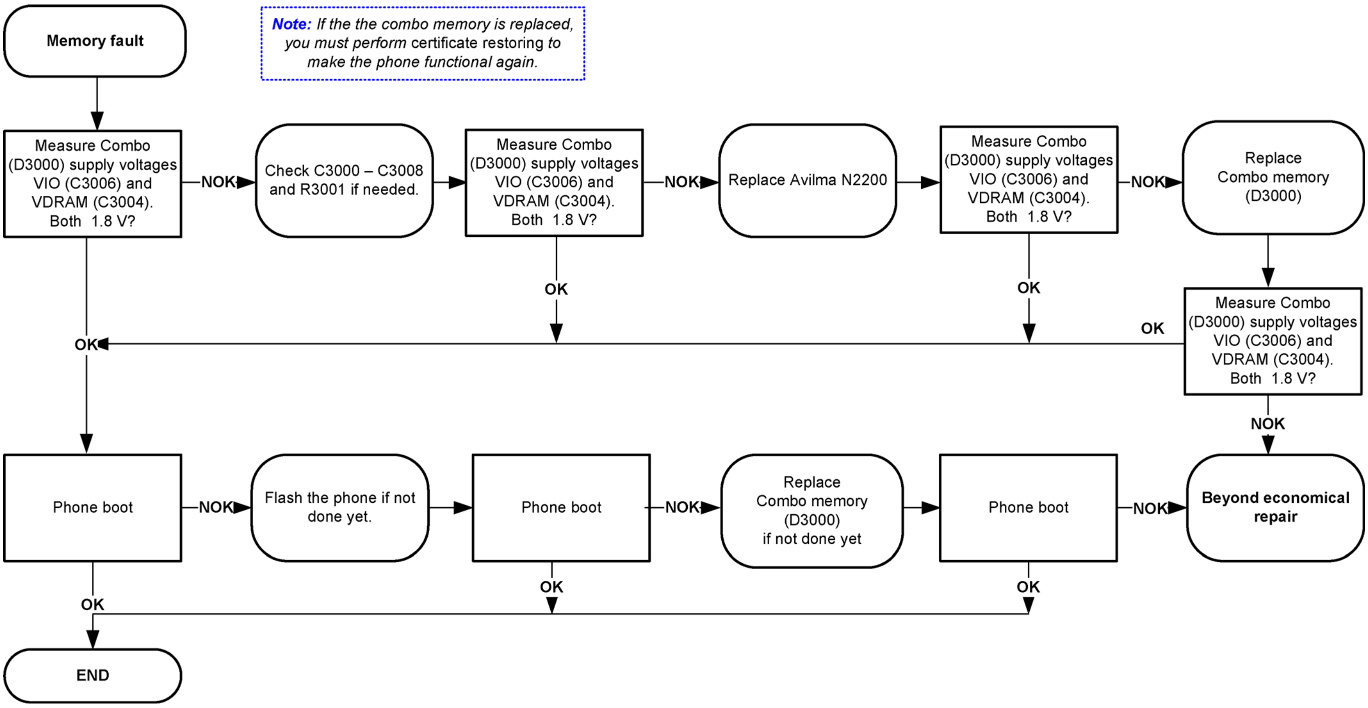
When flashing has started

File
Control
Setup
Measure
Analyze
Utilities
Help
1:24 PM
BSI
PURX
T
More (1of 2)
Clear All

Figure 16 Flashing pic 2. Take single triggered measurement for the rise of the BSI signal

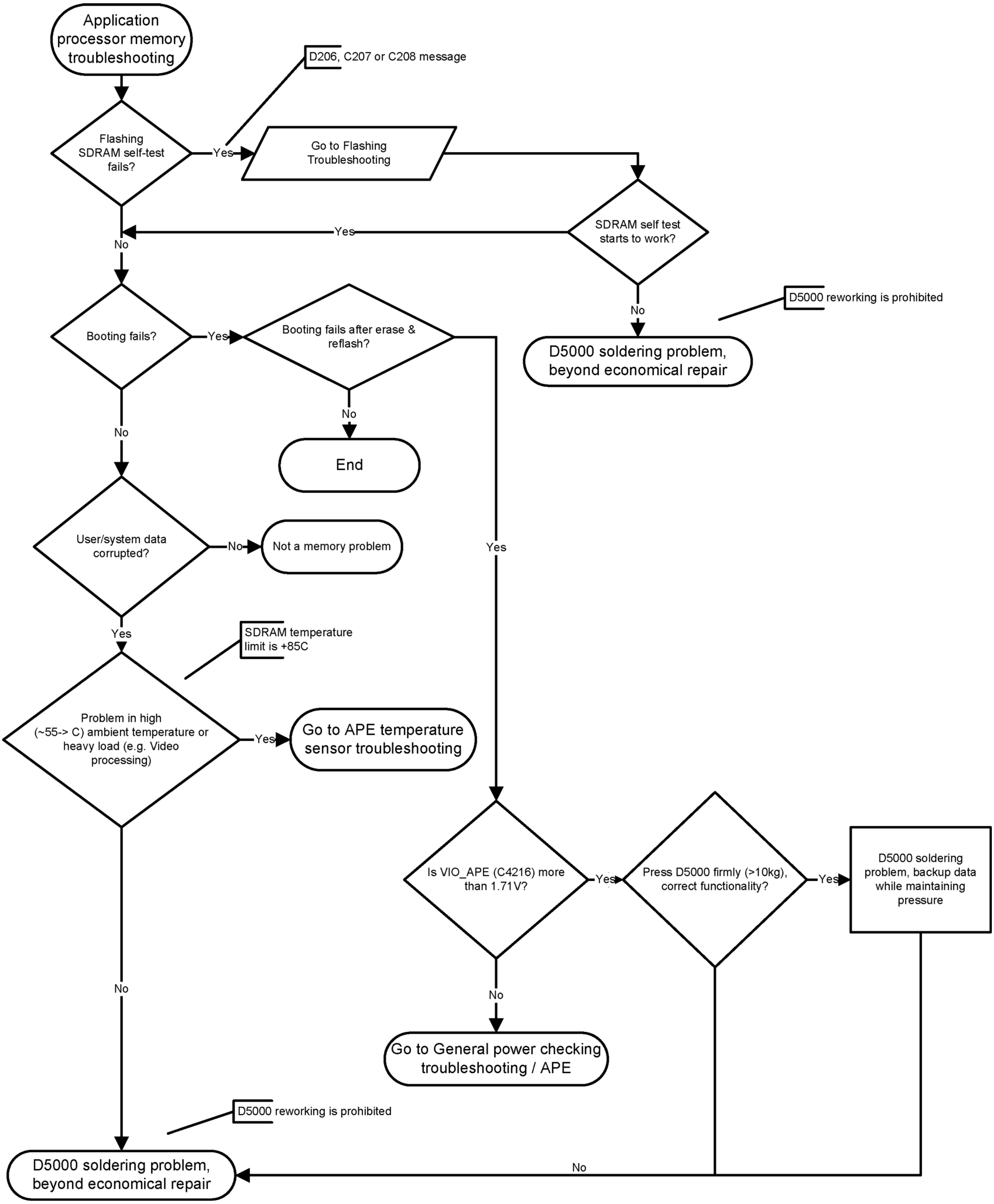
Combo memory fault troubleshooting

Troubleshooting flow


Memory fault
Note: If the the combo memory is replaced, you must perform certificate restoring to make the phone functional again.
Measure Combo (D3000) supply voltages VIO (C3006) and VDRAM (C3004). Both 1.8 V?
NOK
Check C3000 – C3008 and R3001 if needed.
Measure Combo (D3000) supply voltages VIO (C3006) and VDRAM (C3004). Both 1.8 V?
NOK
Replace Avilma N2200
Measure Combo (D3000) supply voltages VIO (C3006) and VDRAM (C3004). Both 1.8 V?
NOK
Replace Combo memory (D3000)
OK
OK
OK
OK
Measure Combo (D3000) supply voltages VIO (C3006) and VDRAM (C3004). Both 1.8 V?
NOK
Phone boot
NOK
Flash the phone if not done yet.
Phone boot
NOK
Replace Combo memory (D3000) if not done yet
Phone boot
NOK
Beyond economical repair
OK
OK
OK
END

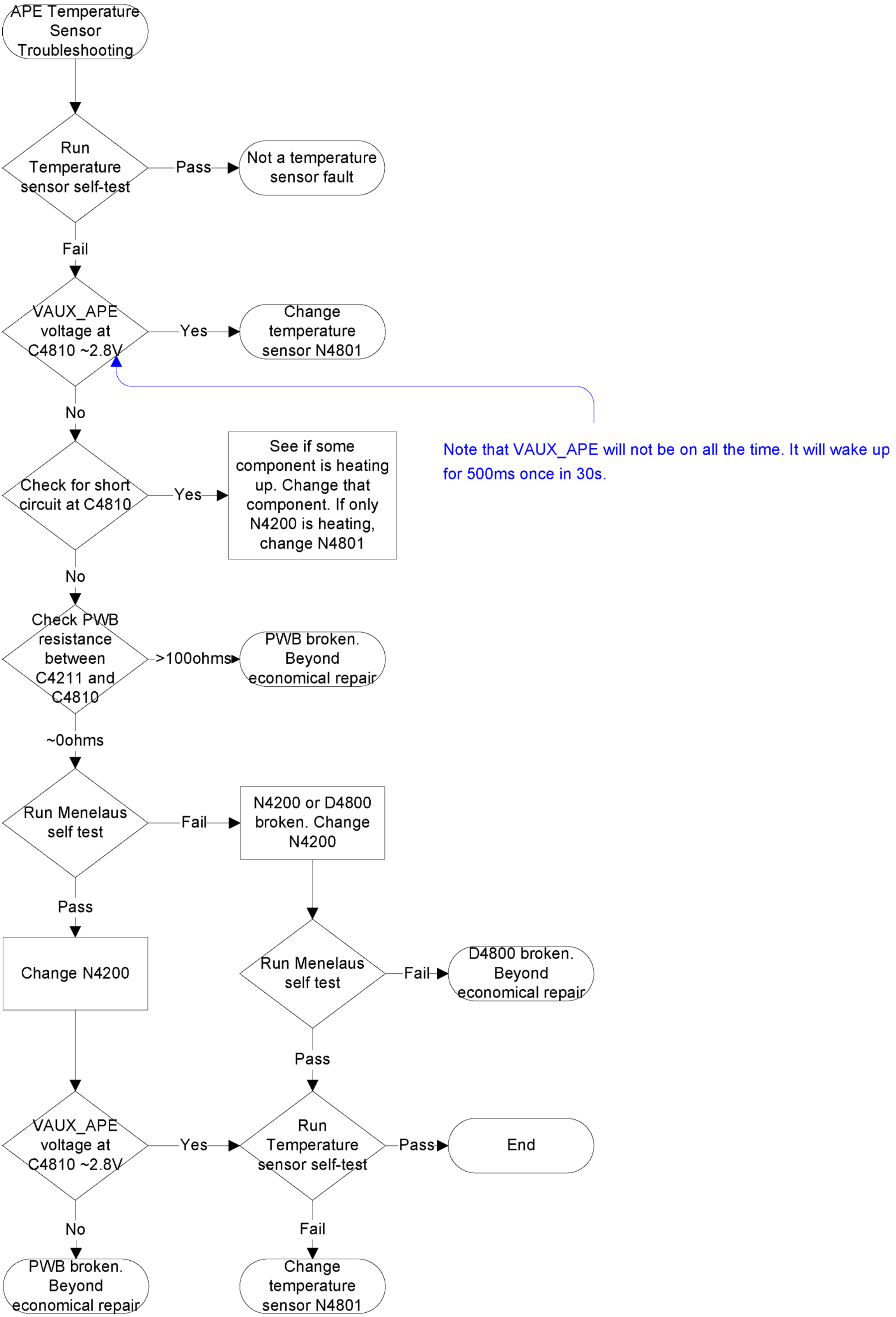
Application processor memory troubleshooting

Troubleshooting flow


Application processor memory troubleshooting
Flashing SDRAM self-test fails?
Yes
D206, C207 or C208 message
Go to Flashing Troubleshooting
SDRAM self test starts to work?
Yes
No
No
D5000 reworking is prohibited
D5000 soldering problem, beyond economical repair
Booting fails?
Yes
Booting fails after erase & reflash?
No
End
No
User/system data corrupted?
No
Not a memory problem
Yes
Yes
SDRAM temperature limit is +85C
Problem in high (~55-> C) ambient temperature or heavy load (e.g. Video processing)
Yes
Go to APE temperature sensor troubleshooting
Is VIO_APE (C4216) more than 1.71V?
Yes
Press D5000 firmly (>10kg), correct functionality?
Yes
D5000 soldering problem, backup data while maintaining pressure
No
Go to General power checking troubleshooting / APE
No
D5000 reworking is prohibited
D5000 soldering problem, beyond economical repair
No

APE temperature sensor troubleshooting

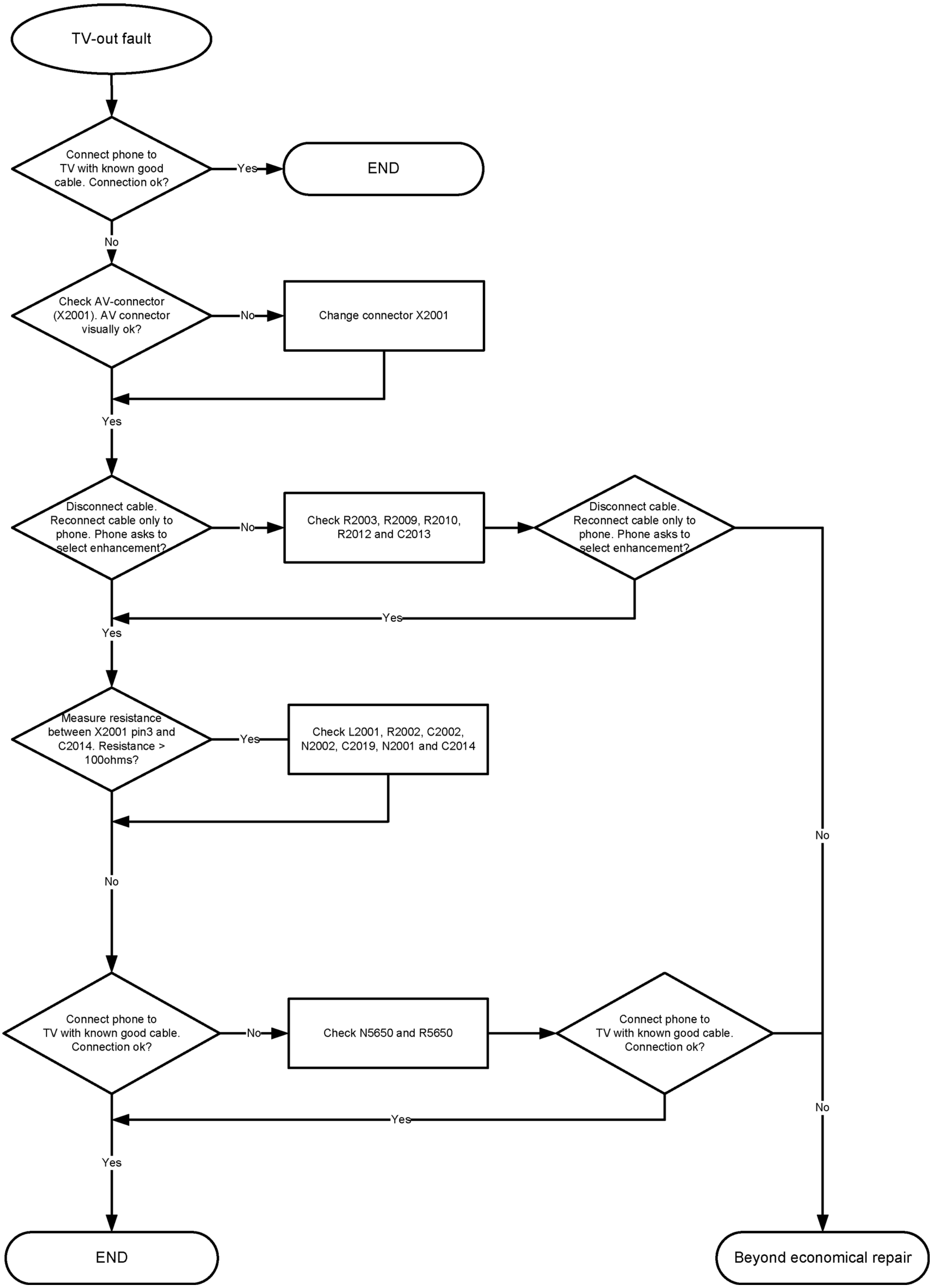
Troubleshooting flow


APE Temperature Sensor Troubleshooting
Run Temperature sensor self-test
Pass
Not a temperature sensor fault
Fail
VAUX_APE voltage at C4810 ~2.8V
Yes
Change temperature sensor N4801
No
Check for short circuit at C4810
Yes
See if some component is heating up. Change that component. If only N4200 is heating, change N4801
No
Check PWB resistance between C4211 and C4810
>100ohms
PWB broken. Beyond economical repair
~0ohms
Run Menelaus self test
Fail
N4200 or D4800 broken. Change N4200
Pass
Change N4200
Run Menelaus self test
Fail
D4800 broken. Beyond economical repair
Pass
VAUX_APE voltage at C4810 ~2.8V
Yes
Run Temperature sensor self-test
Pass
End
No
PWB broken. Beyond economical repair
Fail
Change temperature sensor N4801

Note that VAUX_APE will not be on all the time. It will wake up for 500ms once in 30s.

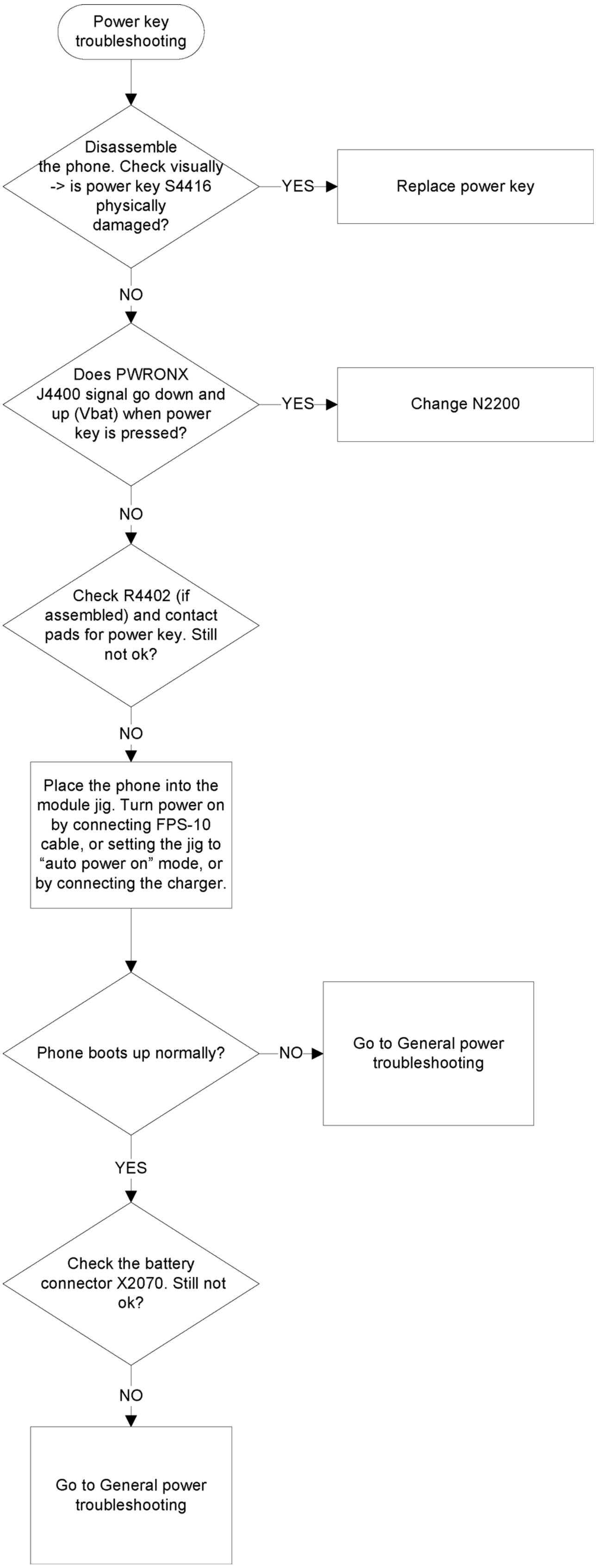
TV-out troubleshooting

Troubleshooting flow


TV-out fault
Connect phone to TV with known good cable. Connection ok?
Yes
END
No
Check AV-connector (X2001). AV connector visually ok?
No
Change connector X2001
Yes
Disconnect cable. Reconnect cable only to phone. Phone asks to select enhancement?
No
Check R2003, R2009, R2010, R2012 and C2013
Disconnect cable. Reconnect cable only to phone. Phone asks to select enhancement?
Yes
Yes
Measure resistance between X2001 pin3 and C2014. Resistance > 100ohms?
Yes
Check L2001, R2002, C2002, N2002, C2019, N2001 and C2014
No
No
Connect phone to TV with known good cable. Connection ok?
No
Check N5650 and R5650
Connect phone to TV with known good cable. Connection ok?
Yes
No
Yes
END
Beyond economical repair

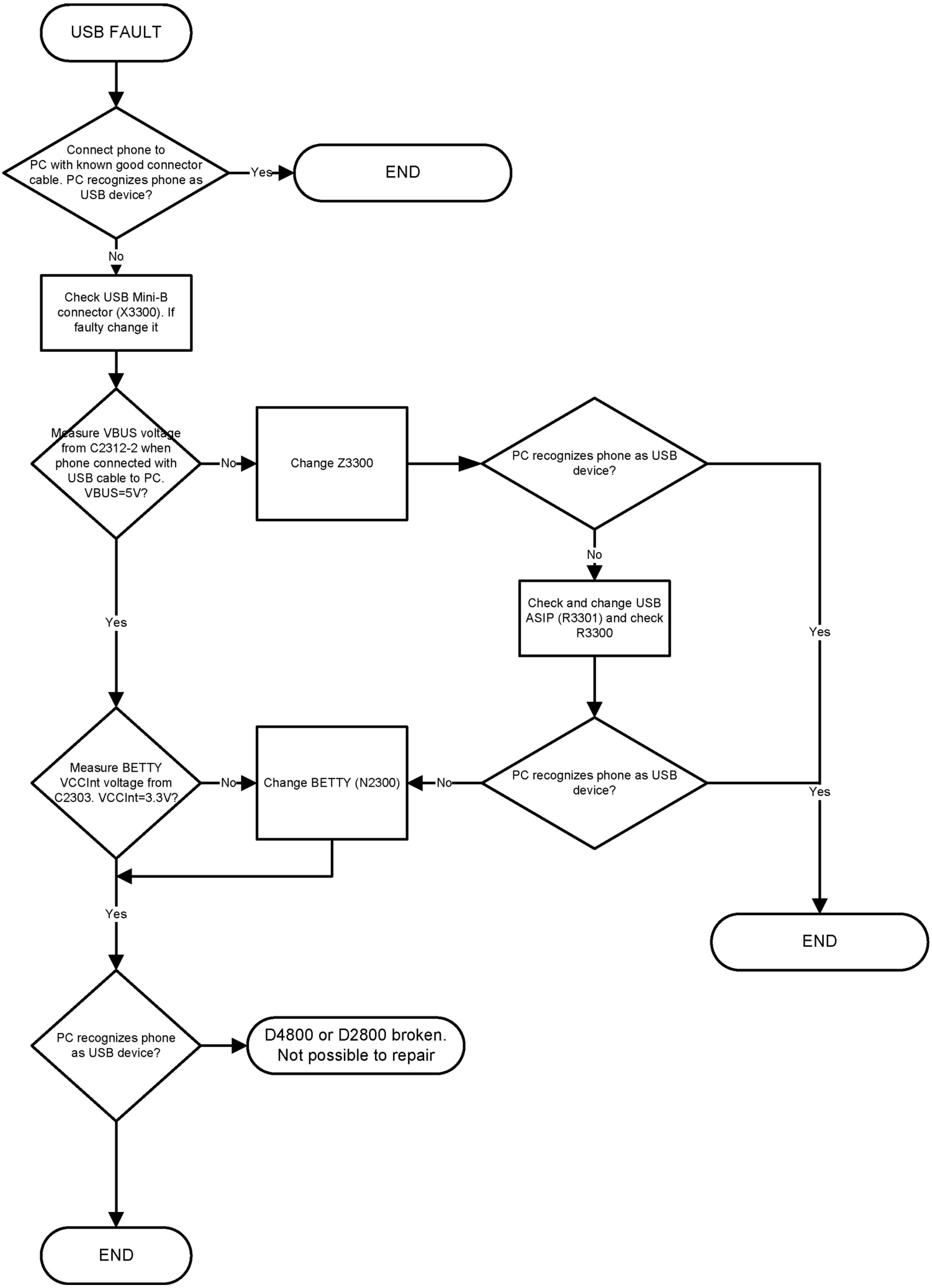
Power key troubleshooting

Troubleshooting flow


Power key troubleshooting
Disassemble the phone. Check visually -> is power key S4416 physically damaged?
YES
Replace power key
NO
Does PWRONX J4400 signal go down and up (Vbat) when power key is pressed?
YES
Change N2200
NO
Check R4402 (if assembled) and contact pads for power key. Still not ok?
NO
Place the phone into the module jig. Turn power on by connecting FPS-10 cable, or setting the jig to “auto power on” mode, or by connecting the charger.
Phone boots up normally?
NO
Go to General power troubleshooting
YES
Check the battery connector X2070. Still not ok?
NO
Go to General power troubleshooting

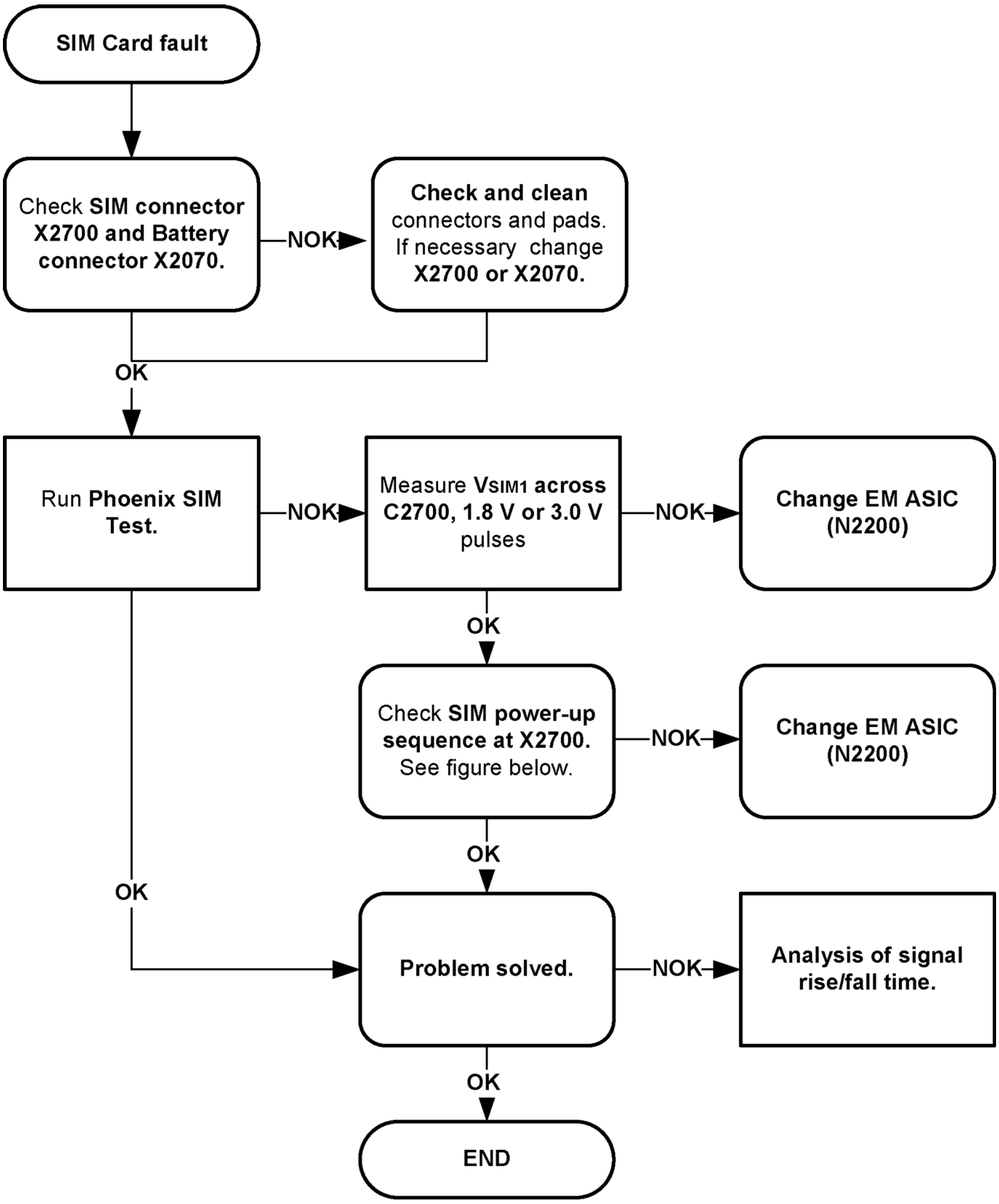
USB interface troubleshooting

Troubleshooting flow

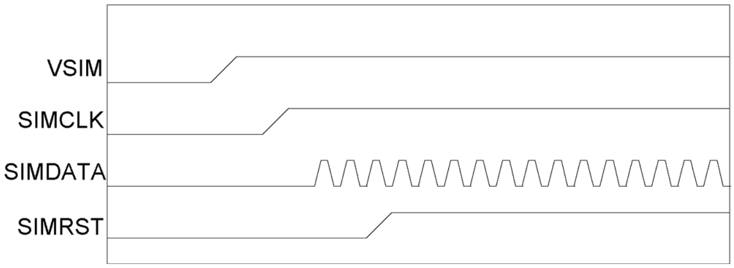

USB FAULT
Connect phone to PC with known good connector cable. PC recognizes phone as USB device?
Yes
END
No
Check USB Mini-B connector (X3300). If faulty change it
Measure VBUS voltage from C2312-2 when phone connected with USB cable to PC. VBUS=5V?
No
Change Z3300
PC recognizes phone as USB device?
No
Check and change USB ASIP (R3301) and check R3300
Yes
Yes
Measure BETTY VCCInt voltage from C2303. VCCInt=3.3V?
No
Change BETTY (N2300)
No
PC recognizes phone as USB device?
Yes
Yes
END
PC recognizes phone as USB device?
D4800 or D2800 broken. Not possible to repair
END

SIM card troubleshooting

Troubleshooting flow

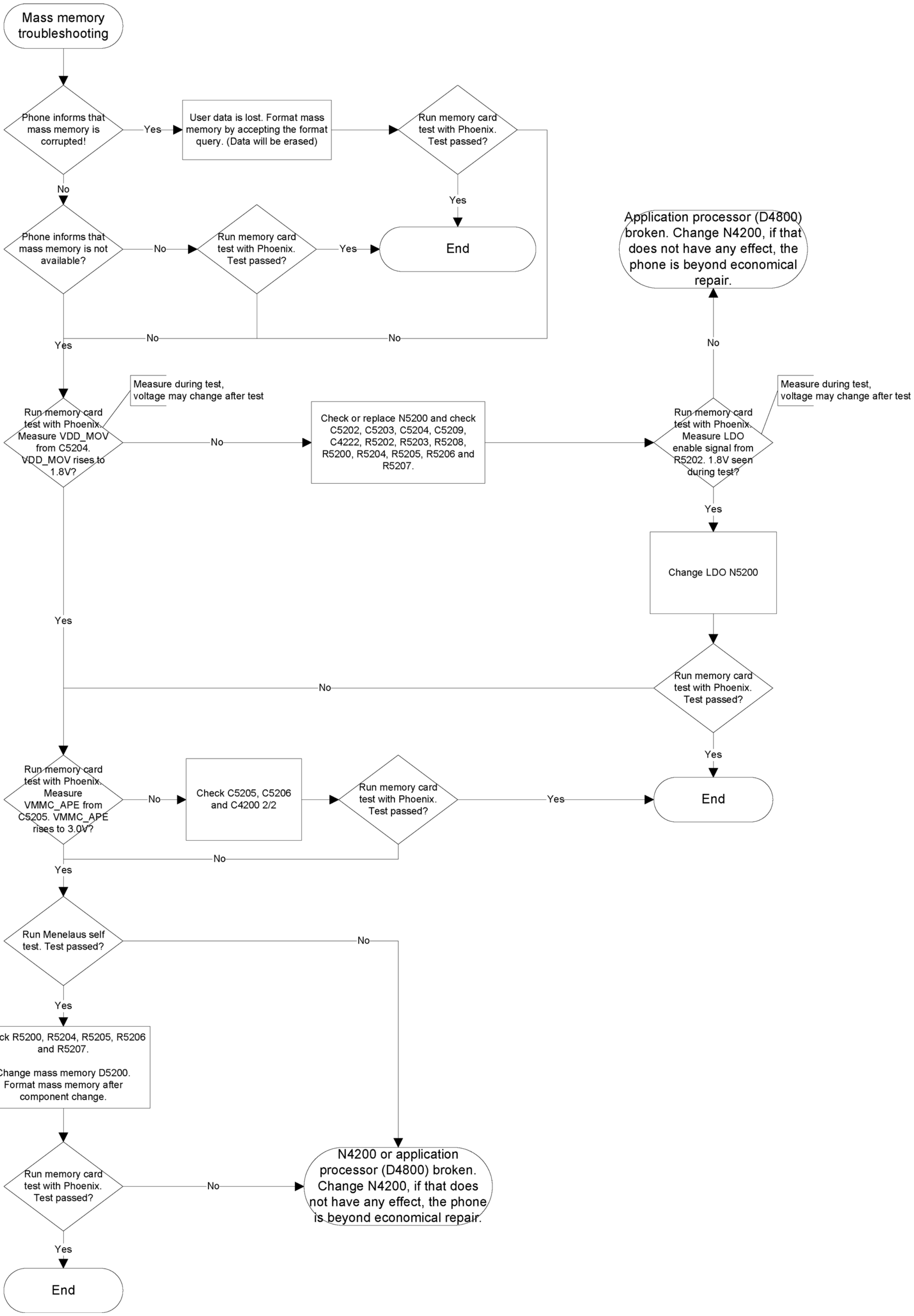

SIM Card fault
Check SIM connector X2700 and Battery connector X2070.
NOK
Check and clean connectors and pads. If necessary change X2700 or X2070.
OK
Run Phoenix SIM Test.
NOK
Measure VSIM1 across C2700, 1.8 V or 3.0 V pulses
NOK
Change EM ASIC (N2200)
OK
Check SIM power-up sequence at X2700. See figure below.
NOK
Change EM ASIC (N2200)
OK
OK
Problem solved.
NOK
Analysis of signal rise/fall time.
OK
END

SIM power-up sequence


VSIM
SIMCLK
SIMDATA
SIMRST

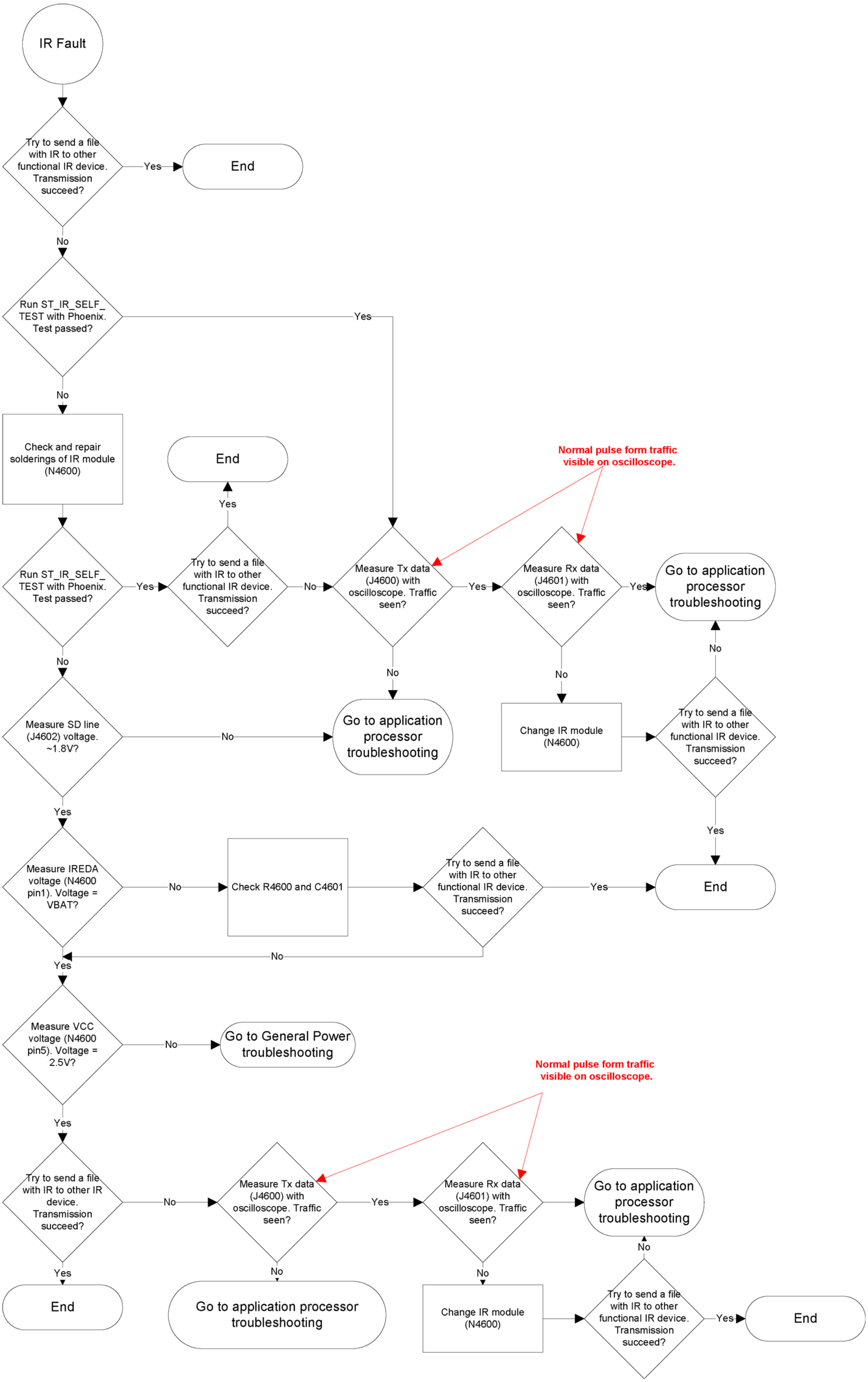
Mass memory troubleshooting

Troubleshooting flow


Mass memory troubleshooting
Phone informs that mass memory is corrupted!
Yes
User data is lost. Format mass memory by accepting the format query. (Data will be erased)
Run memory card test with Phoenix. Test passed?
Yes
No
Phone informs that mass memory is not available?
No
Run memory card test with Phoenix. Test passed?
Yes
End
No
No
Yes
Application processor (D4800) broken. Change N4200, if that does not have any effect, the phone is beyond economical repair.
No
Measure during test, voltage may change after test
Run memory card test with Phoenix. Measure VDD_MOV from C5204. VDD_MOV rises to 1.8V?
No
Check or replace N5200 and check C5202, C5203, C5204, C5209, C4222, R5202, R5203, R5208, R5200, R5204, R5205, R5206 and R5207.
Measure during test, voltage may change after test
Run memory card test with Phoenix. Measure LDO enable signal from R5202. 1.8V seen during test?
Yes
Change LDO N5200
Yes
No
Run memory card test with Phoenix. Test passed?
Yes
Run memory card test with Phoenix. Measure VMMC_APE from C5205. VMMC_APE rises to 3.0V?
No
Check C5205, C5206 and C4200 2/2
Run memory card test with Phoenix. Test passed?
Yes
End
No
Yes
Run Menelaus self test. Test passed?
No
Yes
Check R5200, R5204, R5205, R5206 and R5207.
Change mass memory D5200. Format mass memory after component change.
N4200 or application processor (D4800) broken. Change N4200, if that does not have any effect, the phone is beyond economical repair.
Run memory card test with Phoenix. Test passed?
No
Yes
End

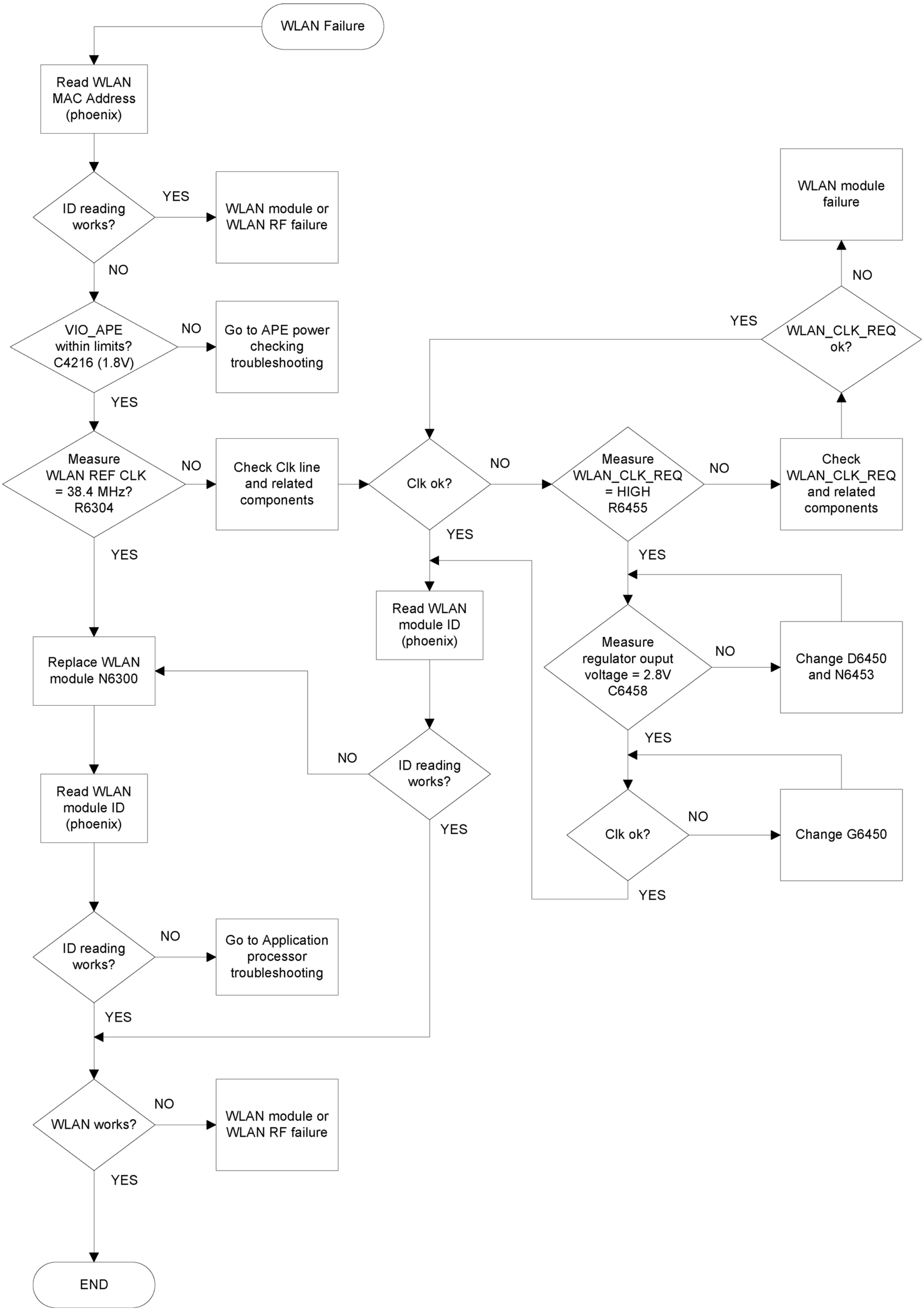
IrDA troubleshooting

Troubleshooting flow


IR Fault
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
End
No
Run ST_IR_SELF_TEST with Phoenix. Test passed?
Yes
No
Check and repair solderings of IR module (N4600)
End
Yes
Normal pulse form traffic visible on oscilloscope.
Run ST_IR_SELF_TEST with Phoenix. Test passed?
Yes
Try to send a file with IR to other functional IR device. Transmission succeed?
No
Measure Tx data (J4600) with oscilloscope. Traffic seen?
Yes
Measure Rx data (J4601) with oscilloscope. Traffic seen?
Yes
Go to application processor troubleshooting
No
No
No
No
Measure SD line (J4602) voltage. ~1.8V?
No
Go to application processor troubleshooting
Change IR module (N4600)
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
Yes
Measure IREDA voltage (N4600 pin1). Voltage = VBAT?
No
Check R4600 and C4601
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
End
No
Yes
Measure VCC voltage (N4600 pin5). Voltage = 2.5V?
No
Go to General Power troubleshooting
Normal pulse form traffic visible on oscilloscope.
Yes
Try to send a file with IR to other IR device. Transmission succeed?
No
Measure Tx data (J4600) with oscilloscope. Traffic seen?
Yes
Measure Rx data (J4601) with oscilloscope. Traffic seen?
Go to application processor troubleshooting
No
Yes
No
No
End
Go to application processor troubleshooting
Change IR module (N4600)
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
End

WLAN interface troubleshooting

Troubleshooting flow


WLAN Failure
Read WLAN MAC Address (phoenix)
ID reading works?
YES
WLAN module or WLAN RF failure
NO
VIO_APE within limits? C4216 (1.8V)
NO
Go to APE power checking troubleshooting
YES
Measure WLAN REF CLK = 38.4 MHz? R6304
NO
Check Clk line and related components
Clk ok?
NO
Measure WLAN_CLK_REQ = HIGH R6455
NO
Check WLAN_CLK_REQ and related components
WLAN_CLK_REQ ok?
NO
WLAN module failure
YES
YES
YES
Read WLAN module ID (phoenix)
YES
Measure regulator ouput voltage = 2.8V C6458
NO
Change D6450 and N6453
YES
Clk ok?
NO
Change G6450
YES
ID reading works?
NO
YES
YES
Replace WLAN module N6300
Read WLAN module ID (phoenix)
ID reading works?
NO
Go to Application processor troubleshooting
YES
WLAN works?
NO
WLAN module or WLAN RF failure
YES
END

Keyboard troubleshooting

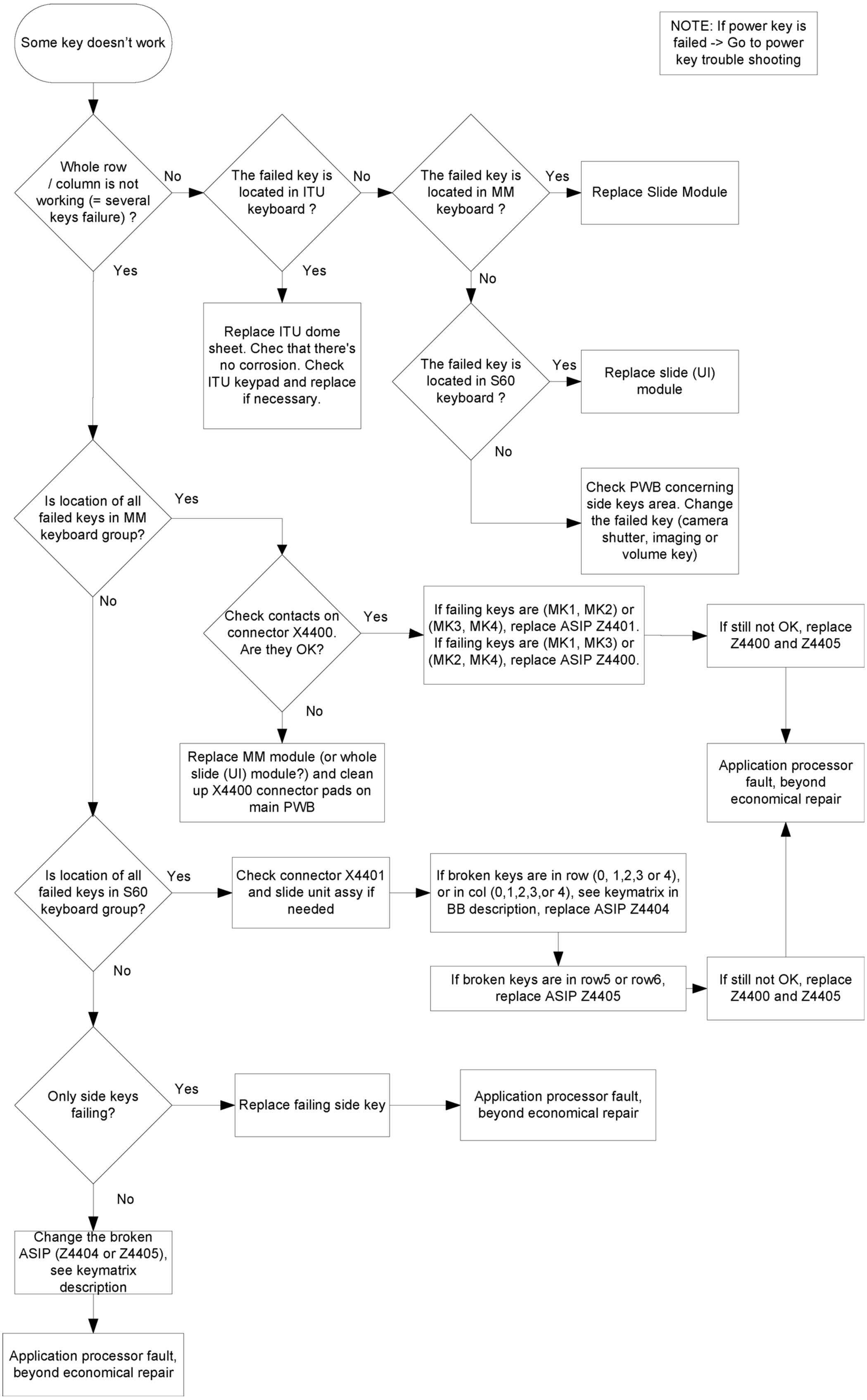
Context

There are two possible failure modes in the keyboard module:

1. One or more keys are stuck, so that the key(s) does not react when you press a keydome. This kind of failure is caused by mechanical reasons (dirt, corrosion).
2. Malfunction of several keys at the same time; this happens when one or more rows or columns are failing (shortcut or open connection). For a more detailed description of the keyboard and keymatrix, see section **Keyboard**.

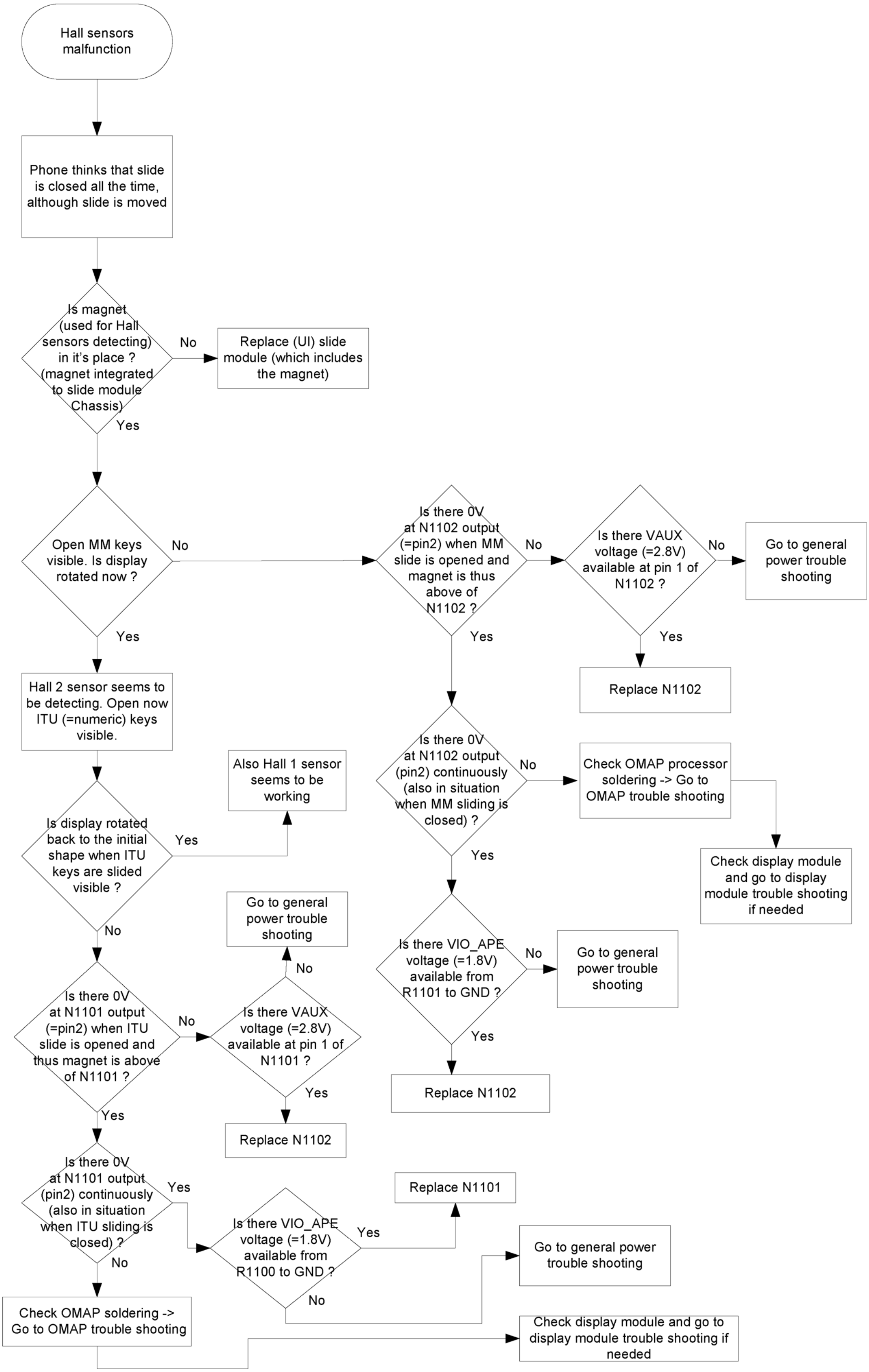
If the failure mode is not clear, start with the **Keyboard Test** in *Phoenix*.

Troubleshooting flow


Some key doesn't work
NOTE: If power key is failed -> Go to power key trouble shooting
Whole row / column is not working (= several keys failure) ?
No
Yes
The failed key is located in ITU keyboard ?
No
Yes
The failed key is located in MM keyboard ?
Yes
No
Replace Slide Module
Replace ITU dome sheet. Chec that there's no corrosion. Check ITU keypad and replace if necessary.
The failed key is located in S60 keyboard ?
Yes
No
Replace slide (UI) module
Check PWB concerning side keys area. Change the failed key (camera shutter, imaging or volume key)
Is location of all failed keys in MM keyboard group?
Yes
No
Check contacts on connector X4400. Are they OK?
Yes
No
If failing keys are (MK1, MK2) or (MK3, MK4), replace ASIP Z4401. If failing keys are (MK1, MK3) or (MK2, MK4), replace ASIP Z4400.
If still not OK, replace Z4400 and Z4405
Replace MM module (or whole slide (UI) module?) and clean up X4400 connector pads on main PWB
Application processor fault, beyond economical repair
Is location of all failed keys in S60 keyboard group?
Yes
No
Check connector X4401 and slide unit assy if needed
If broken keys are in row (0, 1,2,3 or 4), or in col (0,1,2,3,or 4), see keymatrix in BB description, replace ASIP Z4404
If broken keys are in row5 or row6, replace ASIP Z4405
If still not OK, replace Z4400 and Z4405
Only side keys failing?
Yes
No
Replace failing side key
Application processor fault, beyond economical repair
Change the broken ASIP (Z4404 or Z4405), see keymatrix description
Application processor fault, beyond economical repair

Hall sensor troubleshooting

Troubleshooting flow


Hall sensors malfunction
Phone thinks that slide is closed all the time, although slide is moved
Is magnet (used for Hall sensors detecting) in it's place ? (magnet integrated to slide module Chassis)
No
Replace (UI) slide module (which includes the magnet)
Yes
Open MM keys visible. Is display rotated now ?
No
Is there 0V at N1102 output (=pin2) when MM slide is opened and magnet is thus above of N1102 ?
No
Is there VAUX voltage (=2.8V) available at pin 1 of N1102 ?
No
Go to general power trouble shooting
Yes
Replace N1102
Yes
Yes
Hall 2 sensor seems to be detecting. Open now ITU (=numeric) keys visible.
Is there 0V at N1102 output (pin2) continuously (also in situation when MM sliding is closed) ?
No
Check OMAP processor soldering -> Go to OMAP trouble shooting
Check display module and go to display module trouble shooting if needed
Yes
Is there VIO_APE voltage (=1.8V) available from R1101 to GND ?
No
Go to general power trouble shooting
Yes
Replace N1102
Also Hall 1 sensor seems to be working
Is display rotated back to the initial shape when ITU keys are slided visible ?
Yes
No
Is there 0V at N1101 output (=pin2) when ITU slide is opened and thus magnet is above of N1101 ?
No
Is there VAUX voltage (=2.8V) available at pin 1 of N1101 ?
No
Go to general power trouble shooting
Yes
Replace N1102
Yes
Is there 0V at N1101 output (pin2) continuously (also in situation when ITU sliding is closed) ?
Yes
Is there VIO_APE voltage (=1.8V) available from R1100 to GND ?
Yes
Replace N1101
No
Go to general power trouble shooting
No
Check OMAP soldering -> Go to OMAP trouble shooting
Check display module and go to display module trouble shooting if needed

FM radio troubleshooting

Context

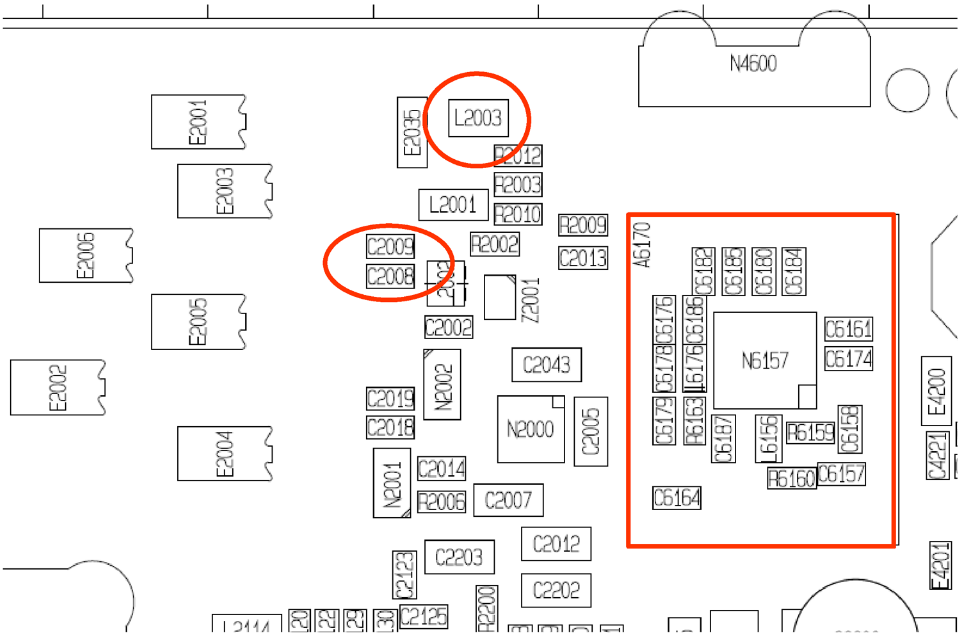
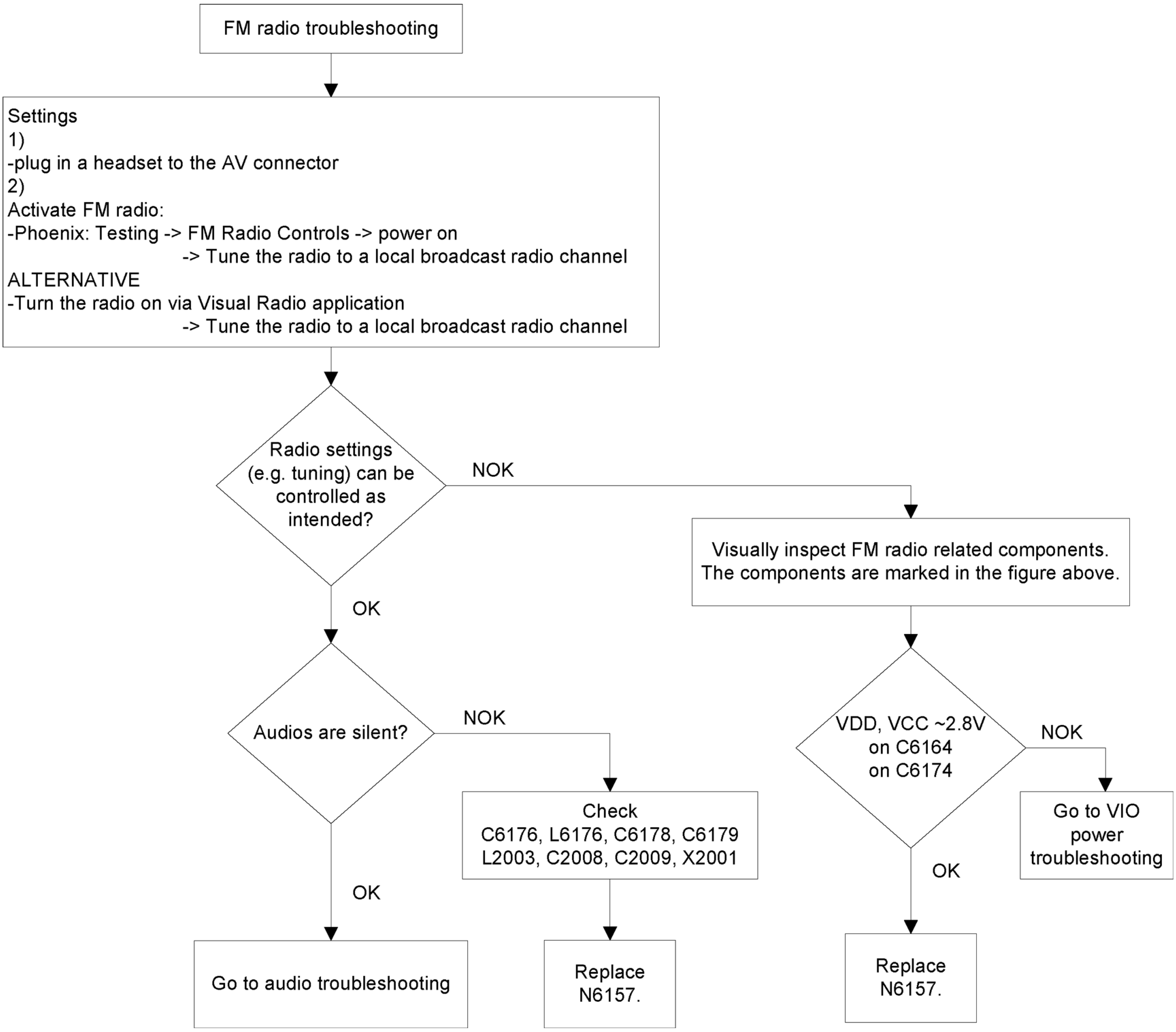

N4600
E2001
E2035
L2003
R2012
E2003
R2003
L2001
R2010
R2009
E2006
C2009
R2002
C2013
A6170
C6182
C6185
C6180
C6184
C2008
Z2001
C2002
E2005
C6175
C6186
C6161
N6157
C2043
C6174
C6178
L6176
E2002
C2019
N2002
E4200
C2018
N2000
C2005
C6179
R6163
C6187
L6156
R6159
C6158
C4221
E2004
C2014
N2001
R2006
C2007
R6160
C6157
C6164
C2012
C2203
E4201
C2123
C2202
R2200
C2125

Figure 17 FM radio placement on the bottom side

Troubleshooting flow


FM radio troubleshooting
Settings
1)
-plug in a headset to the AV connector
2)
Activate FM radio:
-Phoenix: Testing -> FM Radio Controls -> power on
-> Tune the radio to a local broadcast radio channel
ALTERNATIVE
-Turn the radio on via Visual Radio application
-> Tune the radio to a local broadcast radio channel
Radio settings (e.g. tuning) can be controlled as intended?
NOK
Visually inspect FM radio related components. The components are marked in the figure above.
OK
Audios are silent?
NOK
Check C6176, L6176, C6178, C6179 L2003, C2008, C2009, X2001
VDD, VCC ~2.8V on C6164 on C6174
NOK
Go to VIO power troubleshooting
OK
OK
Go to audio troubleshooting
Replace N6157.
Replace N6157.

Certificate restoring for BB5 products

Context

This procedure is performed when the device flash content is changed or corrupted.

All tunings (RF & Baseband, UI) must be done after performing the certificate restoring procedure.

The procedure for certificate restoring is the following:

- Flash the phone with the latest available software using FLS-5 or FPS-10.

  Note: USB flashing does not work for a dead BB5 phone.

- Create a request file.
- Send the file to Nokia by e-mail. Use the following addresses depending on your location:
  - APAC: sydney.service@nokia.com

  - CHINA: repair.ams@nokia.com
  - E&A: salo.repair@nokia.com
- When you receive a reply from Nokia, carry out certificate restoring.
- Tune the phone completely.

  Note: The request won't be accepted without a SX-4 smart card. Before the request, the smart card must be registered in the online database.

- If the phone resets after certificate restoring, reflash the phone again.

Required equipment and setup:

- Latest *Phoenix* service software.
- The latest phone model specific *Phoenix* data package.
- PKD-1 dongle
- SX-4 smart card (Enables BB5 testing and tuning features)
- External smart card reader

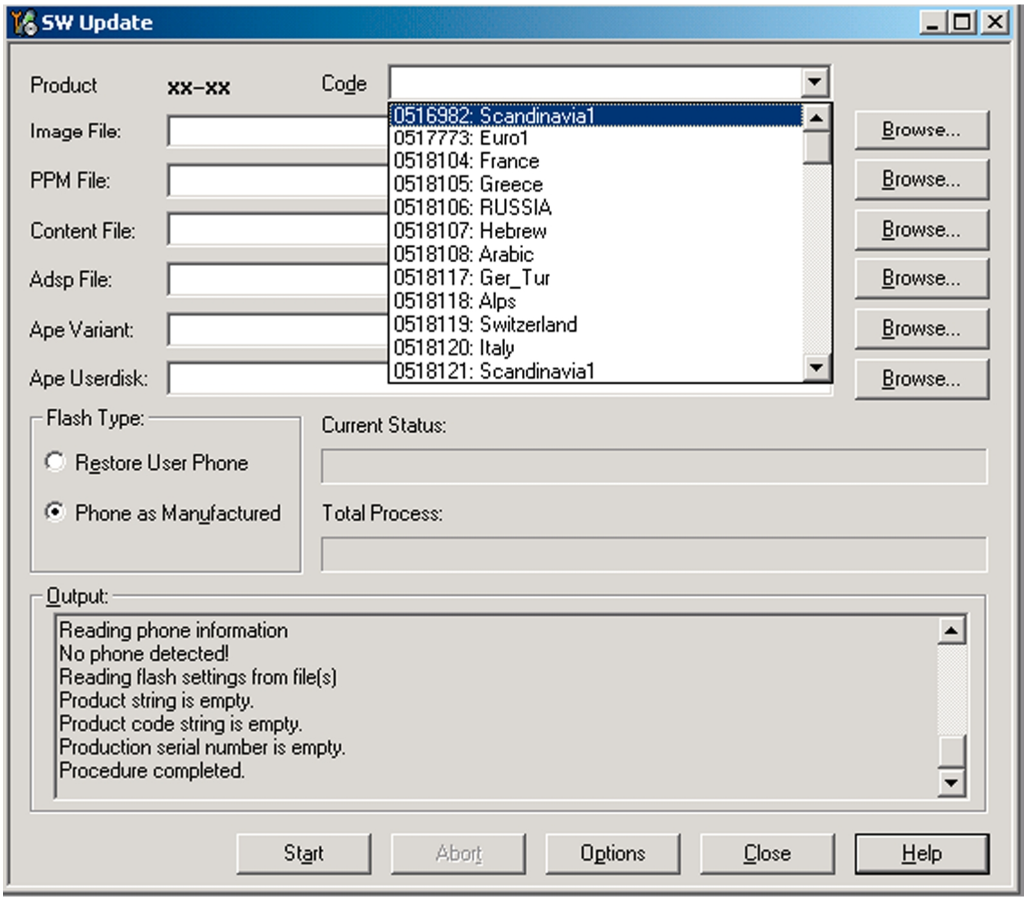
  Note: The smart card reader is only needed when FLS-5 is used. FPS-10 has an integrated smart card reader.

- Activated FLS-5 flash device **OR** FPS-10 flash prommer
- The latest flash update package for FLS-5 flash device or FPS-10 flash prommer
- CU-4 control unit
- USB cable from PC USB Port to CU-4 control unit
- Phone model specific adapter for CU-4 control unit
- PCS-1 cable to power CU-4 from external power supply
- XCS-4 modular cable between flash prommer and CU-4

  Note: CU-4 must be supplied with +12 V from an external power supply in all steps of certificate restoring.

Steps

1. Program the phone software.
   i Start *Phoenix* and login. Make sure the connection has been managed correctly for FLS-5 or FPS-10.
   ii Update the phone MCU software to the latest available version.
   If the new flash is empty and the phone cannot communicate with *Phoenix*, reflash the phone.
   iii Choose the product manually from **File→Open Product**, and click **OK**.
   Wait for the phone type designator (e.g. “RM-1”) to be displayed in the status bar.
   iv Go to **Flashing→Firmware Update** and wait until *Phoenix* reads the product data as shown in the following picture.



SW Update

Product xx-xx

Flash Type:

○ Restore User Phone

● Phone as Manufactured

Output:

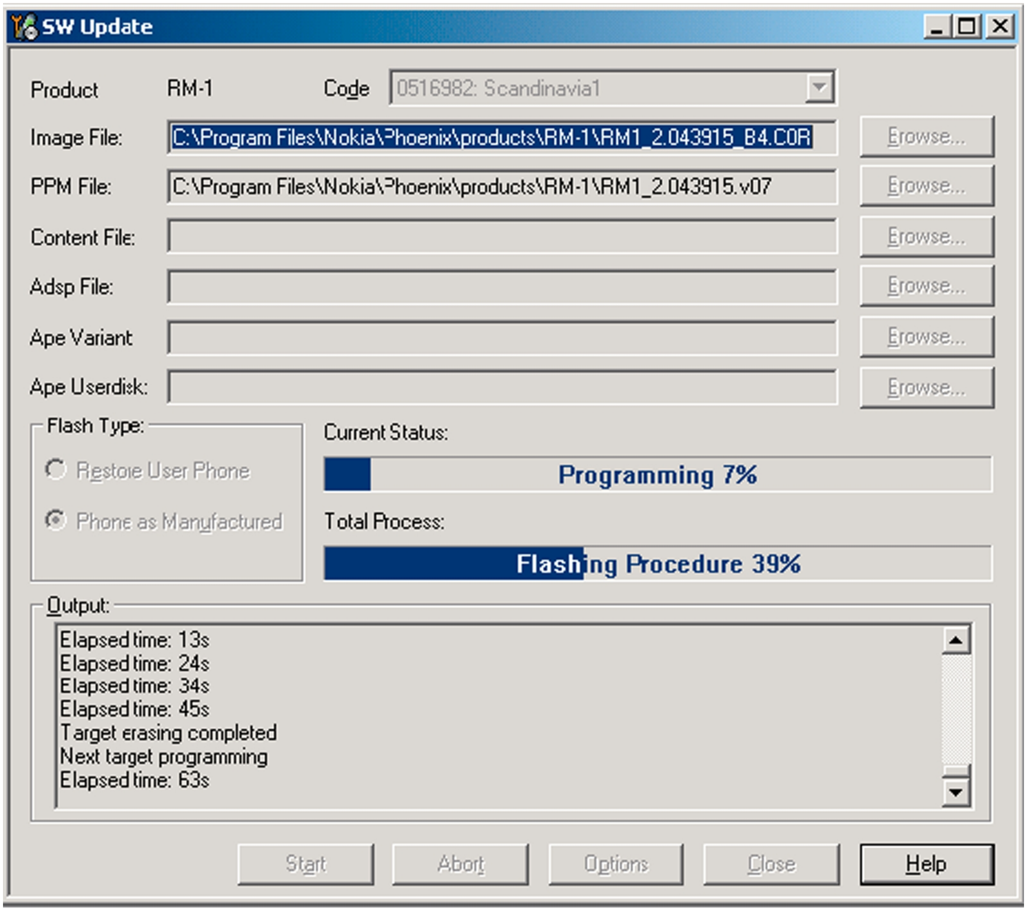
```
Reading phone information
No phone detected!
Reading flash settings from file(s)
Product string is empty.
Product code string is empty.
Production serial number is empty.
Procedure completed.
```

Code
0516982: Scandinavia1
0517773: Euro1
0518104: France
0518105: Greece
0518106: RUSSIA
0518107: Hebrew
0518108: Arabic
0518117: Ger_Tur
0518118: Alps
0518119: Switzerland
0518120: Italy
0518121: Scandinavia1
Image File:
PPM File:
Content File:
Adsp File:
Ape Variant:
Ape Userdisk:
Browse...
Browse...
Browse...
Browse...
Browse...
Browse...
Current Status:
Total Process:
Start
Abort
Options
Close
Help

Product	is automatically set according to the phone support module which was opened manually, but the flash files cannot be found because the correct data cannot be read from the phone automatically.
Code	must be chosen manually, it determines the correct flash files to be used. Please choose the correct product code (can be seen in the phone type label) from the dropdown list.
Flash Type	must be set to **Phone as Manufactured**.

- To continue, click **Start**.

  Progress bars and messages on the screen show actions during phone programming, please wait.


SW Update
Browse...
Browse...
Browse...
Browse...
Browse...
Browse...
Flash Type:
Restore User Phone
Start
Abort
Options
Close
Help

Product: RM-1

Code: 0516982: Scandinavia1

Image File: C:\Program Files\Nokia\Phoenix\products\RM-1\RM1_2.043915_B4.C0R

PPM File: C:\Program Files\Nokia\Phoenix\products\RM-1\RM1_2.043915.v07

Content File:

Adsp File:

Ape Variant

Ape Userdisk:

● Phone as Manufactured

Current Status: Programming 7%

Total Process: Flashing Procedure 39%

Output:

```
Elapsed time: 13s
Elapsed time: 24s
Elapsed time: 34s
Elapsed time: 45s
Target erasing completed
Next target programming
Elapsed time: 63s
```

Programming is completed when *Flashing Completed* message is displayed.

The product type designator and MCU SW version are displayed in the status bar.

vi Close the *SW Update* window and then choose **File→Close Product** .

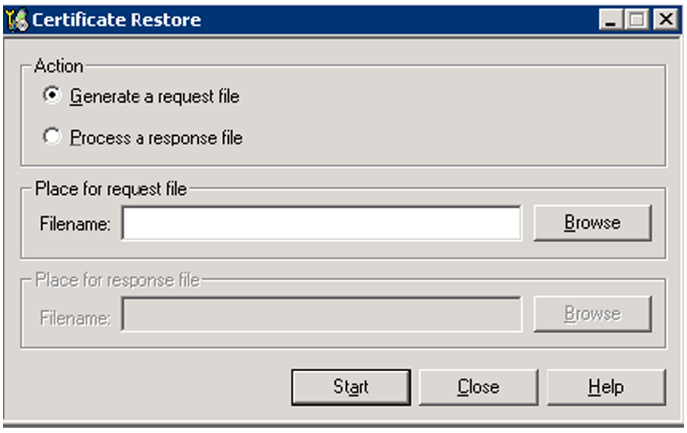
2. Create a *Request* file.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i To connect the phone with *Phoenix*, choose **File→Scan Product** .

ii Choose **Tools→Certificate Restore** .

iii To choose a location for the request file, click **Browse**.

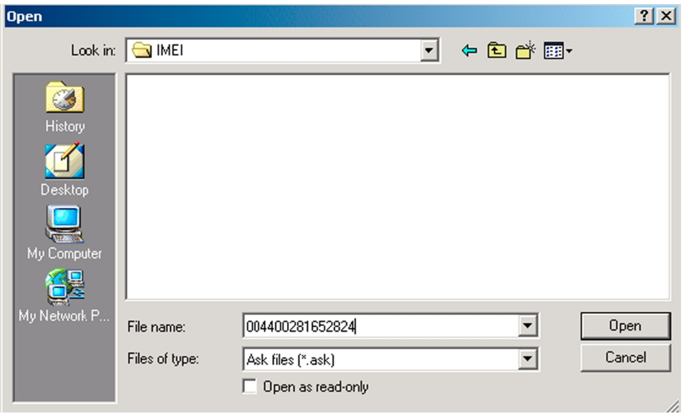

Certificate Restore
Place for request file
Filename:
Browse
Place for response file
Filename:
Browse
Start
Close
Help

Action

● Generate a request file

○ Process a response file

iv Name the file so that you can easily identify it, and click **Open**.


Open
History
Desktop
My Computer
My Network P...
Open
Cancel

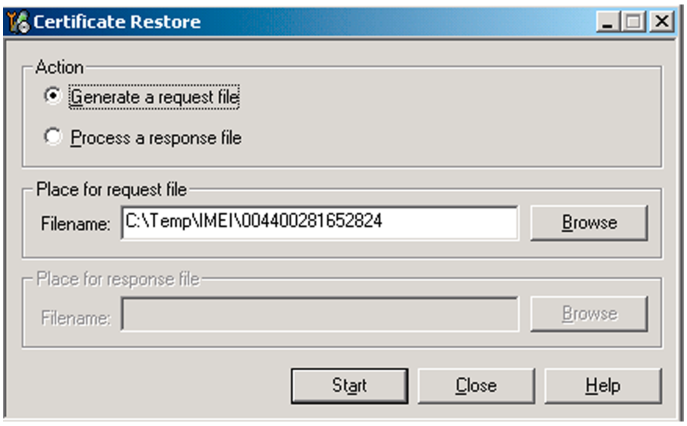
Look in: IMEI

File name: 004400281652824

Files of type: Ask files (*.ask)

☐ Open as read-only

The name of the file and its location are shown.


Certificate Restore
Browse
Browse
Start
Close
Help

Action

● Generate a request file

○ Process a response file

Place for request file

Filename: C:\Temp\IMEI\004400281652824

Place for response file

Filename:

v To create the *Request* file, click **Start**.

vi When the file for certificate restore has been created, send it to Nokia as an e-mail attachment.

3. Restore certificate.

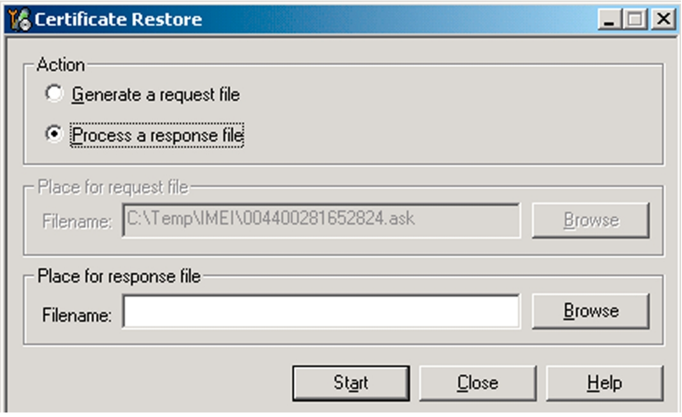
For this procedure, you must supply +12 V to CU-4 from an external power supply.

i Save the reply file sent by Nokia to your computer.

ii Start *Phoenix* service software.

iii Choose **File→Scan Product** .

iv From the **Tools** menu, choose **Certificate Restore** and select **Process a response file** in the *Action* pane.


Certificate Restore
Action
Generate a request file
Place for request file
Place for response file
Browse
Browse
Start
Close
Help

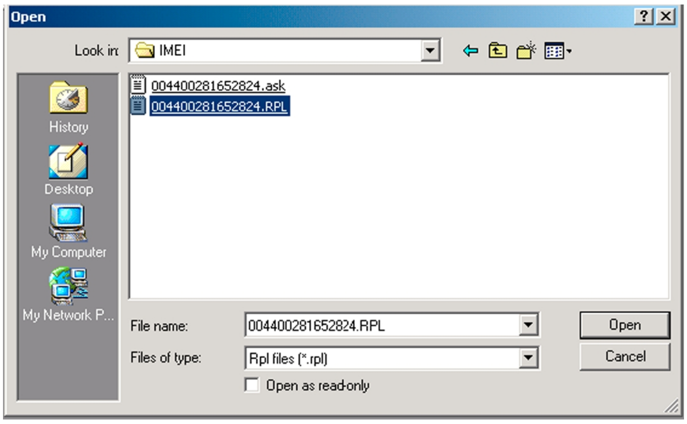
○ Generate a request file
● Process a response file

Place for request file – Filename: C:\Temp\IMEI\004400281652824.ask

Place for response file – Filename:

v To choose the location where response file is saved, click **Browse**.

vi Click **Open**.


Open
History
Desktop
My Computer
My Network P...
Open
Cancel

Look in: IMEI

004400281652824.ask
004400281652824.RPL

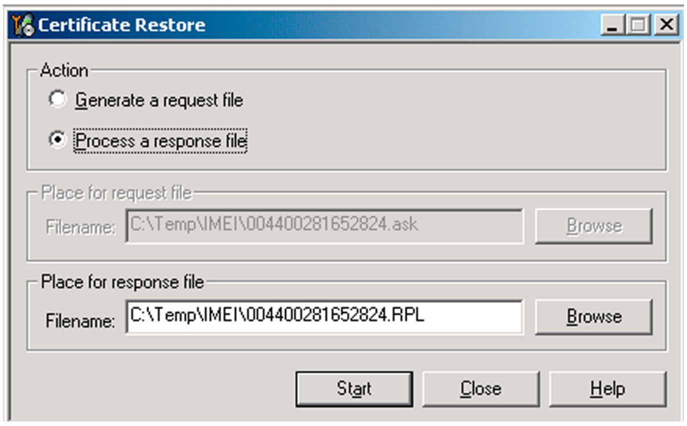
File name: 004400281652824.RPL

Files of type: Rpl files (*.rpl)

☐ Open as read-only

The name of the file and the path where it is located are shown.

vii To write the file to phone, click **Start**.


Certificate Restore
Action
Generate a request file
Place for request file
Place for response file
Browse
Browse
Start
Close
Help

○ Generate a request file
● Process a response file

Place for request file – Filename: C:\Temp\IMEI\004400281652824.ask

Place for response file – Filename: C:\Temp\IMEI\004400281652824.RPL

Next actions

After a successful rewrite, you must retune the phone completely by using *Phoenix* tuning functions.

Important: Perform all tunings: RF, BB, and UI.

GPS troubleshooting

GPS layout and basic test points

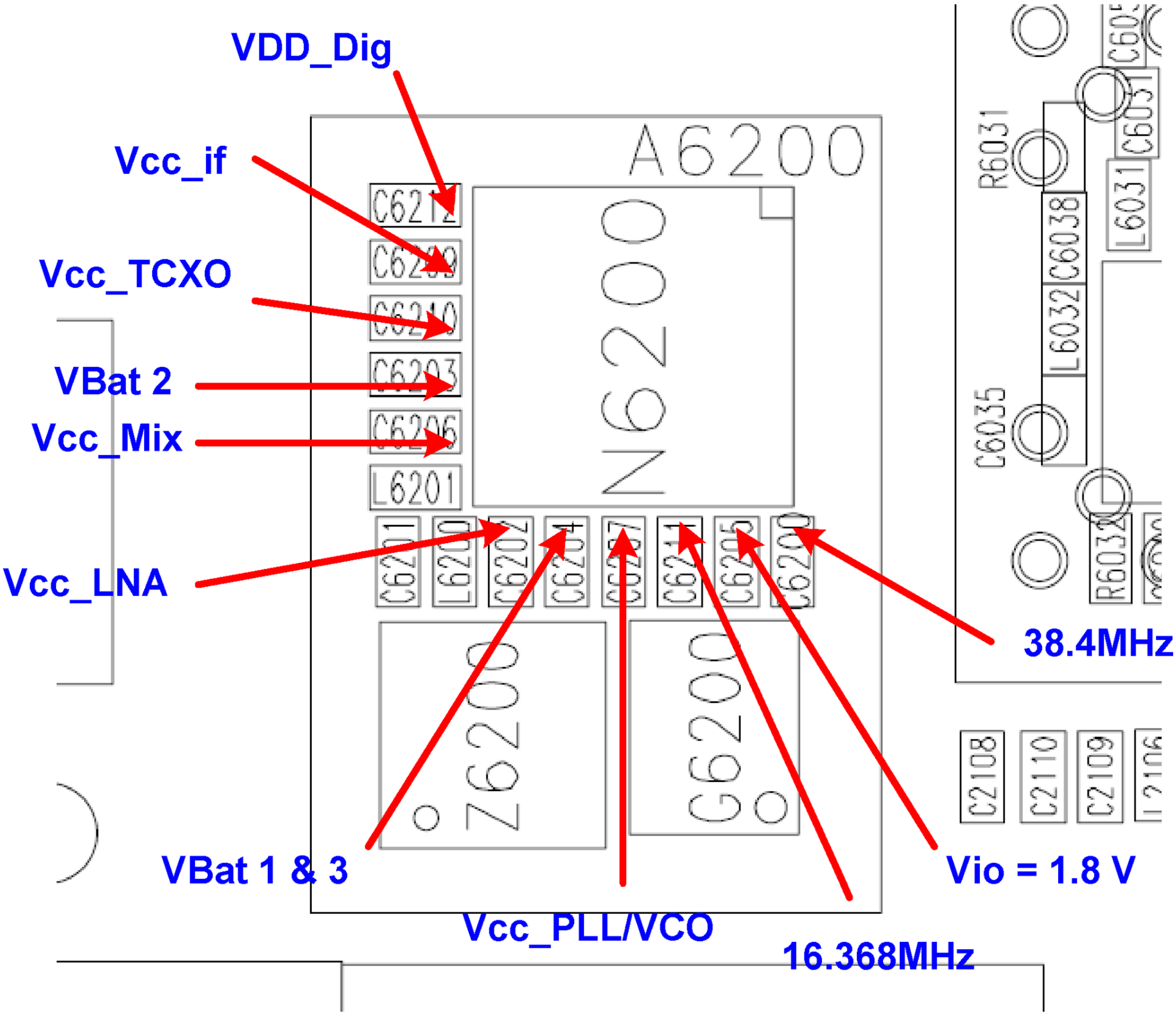

VDD_Dig
Vcc_if
Vcc_TCXO
VBat 2
Vcc_Mix
Vcc_LNA
VBat 1 & 3
Vcc_PLL/VCO
16.368MHz
Vio = 1.8 V
38.4MHz
A6200
N6200
C6212
C6209
C6210
C6203
C6206
L6201
C6201
C6202
C6204
C6207
C6211
C6205
C6200
Z6200
G6200
R6031
C6038
L6032
C6035
L6031
R6032
C2108
C2110
C2109

Figure 18 GPS layout and basic test points

VBat, ASIC internal LDO voltages, and clocks are available as shown in figure above. In addition to these, the following GPS signals are available on the test points:

- GPS_En_Reset – J6201
- U2Tx – J6202 (Activity on this pin indicates the GPS is operating.)
- IO_INT_U1CLK – J6203
- IO_TIMESTAMP_DATRDY – J6204
- SleepX – J2219
- Sleep Clk (RTC) – J2217

GPS settings for Phoenix

GPS control

Context

Use the following to test GPS using Phoenix.

Steps

1. Start Phoenix service software.
2. From the **File** menu, select **Scan Product** and check that the correct product version is displayed.
3. From the **Testing** menu, select **GPS Control**. This opens up *GPS Control* dialogue box, as shown in the figure below, and enables the GPS.

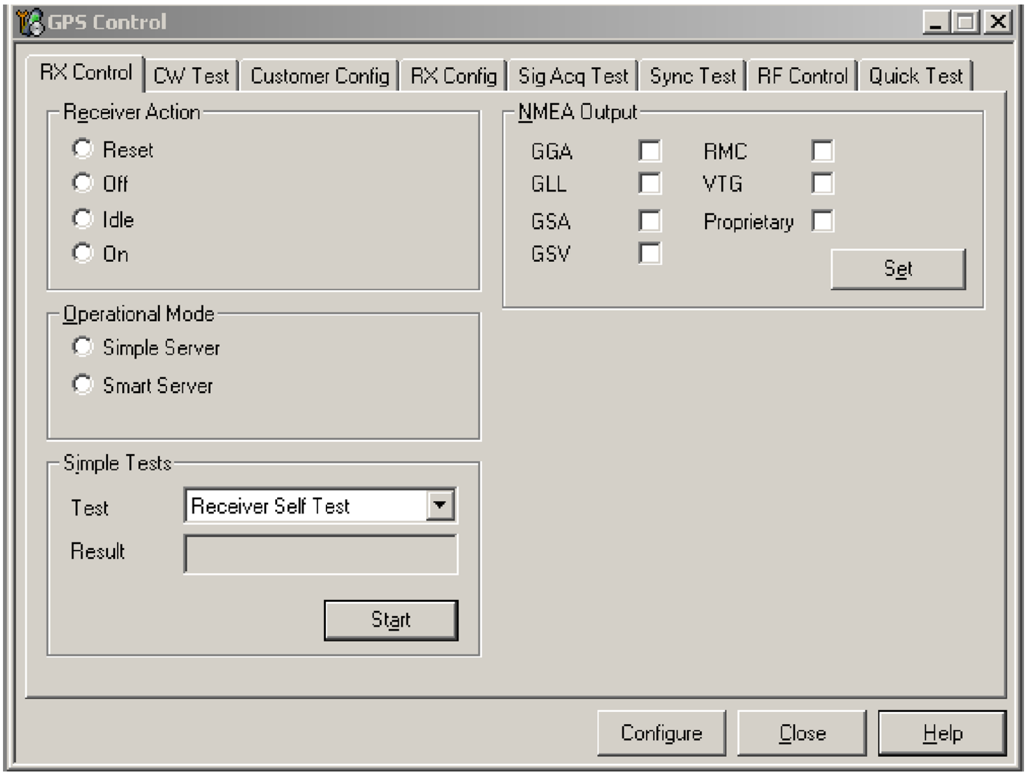

GPS Control
RX Control
CW Test
Customer Config
RX Config
Sig Acq Test
Sync Test
RF Control
Quick Test
Receiver Action
○ Reset
○ Off
○ Idle
○ On
NMEA Output
GGA ☐
GLL ☐
GSA ☐
GSV ☐
RMC ☐
VTG ☐
Proprietary ☐
Set
Operational Mode
○ Simple Server
○ Smart Server
Simple Tests
Test
Receiver Self Test
Result
Start
Configure
Close
Help

Figure 19 GPS Control dialog box

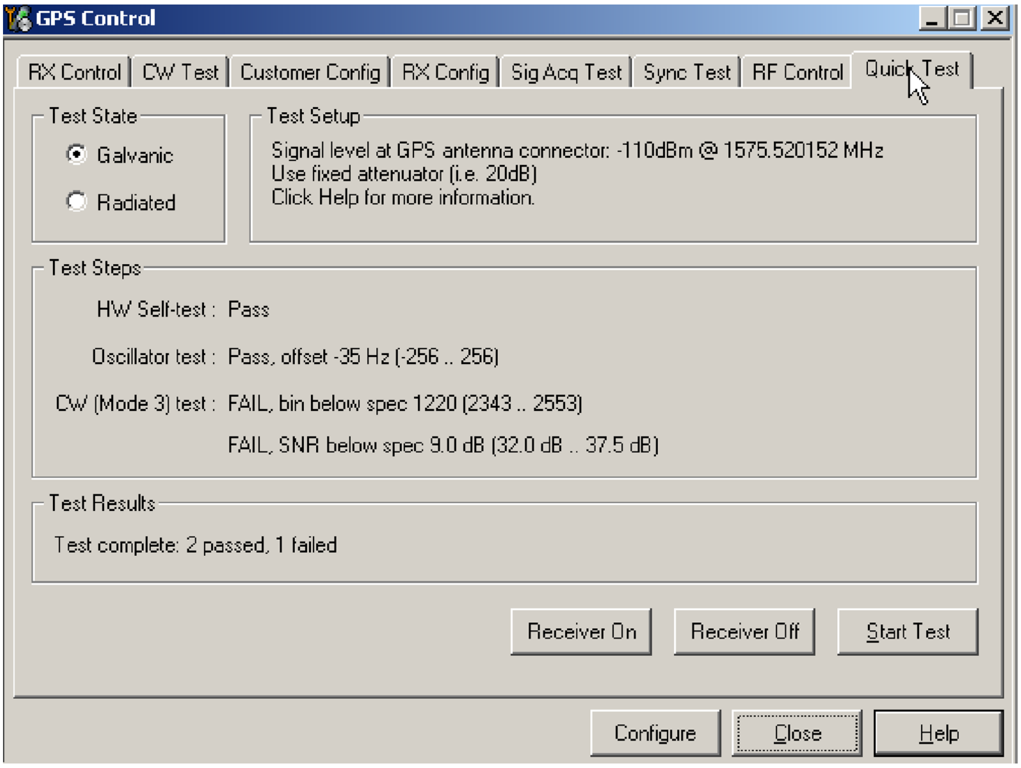
Select **Idle** to confirm the GPS is enabled and is in idle mode; at this point all clocks should be present, GPS_En_Reset & SleepX should be high, and Vdd_Dig, Vcc_TCXO & Vcc_PLL/VCO will be present.

Receiver On turns on all RF sections of the ASIC and so all LDOs will be on. These checks are part of GPS basic checks troubleshooting (page 3–40).

Quick Test window

The *Quick Test* window has all the necessary functionality for GPS troubleshooting. Ensure the test setup is correct and click **Start Test**. (Select **Help** for further information).

This test will perform 3 tests in one; Self Test, Oscillator Test and CW Test, and will provide a Pass/Fail response. It also contains a Receiver On button. These checks are part of GPS troublehsooting (page 3–39).


GPS Control
RX Control
CW Test
Customer Config
RX Config
Sig Acq Test
Sync Test
RF Control
Quick Test
Receiver On
Receiver Off
Start Test
Configure
Close
Help

Test State

● Galvanic

○ Radiated

Test Setup

Signal level at GPS antenna connector: -110dBm @ 1575.520152 MHz
Use fixed attenuator (i.e. 20dB)
Click Help for more information.

Test Steps

HW Self-test : Pass

Oscillator test : Pass, offset -35 Hz (-256 .. 256)

CW (Mode 3) test : FAIL, bin below spec 1220 (2343 .. 2553)

FAIL, SNR below spec 9.0 dB (32.0 dB .. 37.5 dB)

Test Results

Test complete: 2 passed, 1 failed

Figure 20 GPS Quick Test window for GPS troubleshooting

GPS RF test points

The GPS antenna test pads are located on the top side under the keymat as shown in figure "GPS antenna test pads". Checking for a connection between these two test points will confirm that the antenna is working correctly, as well as performing a radiated CW test.

J6210 = GPS Ant

J6211 = GPS Ant Gnd

In order to probe GPS RF test points, inject 1575.52 MHz tone @ -50dBm at the GPS antenna test connector and select **Receiver On**, then probe the GPS RF test points as shown in figure "GPS RF probe points". Compare RF levels with a known reference phone.

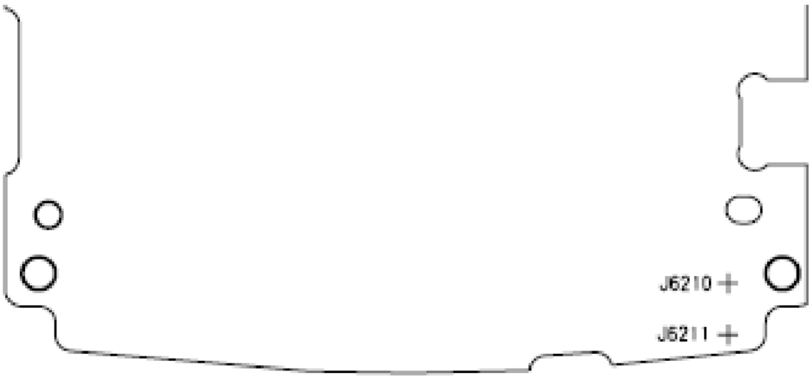

J6210
J6211

Figure 21 GPS antenna test pads

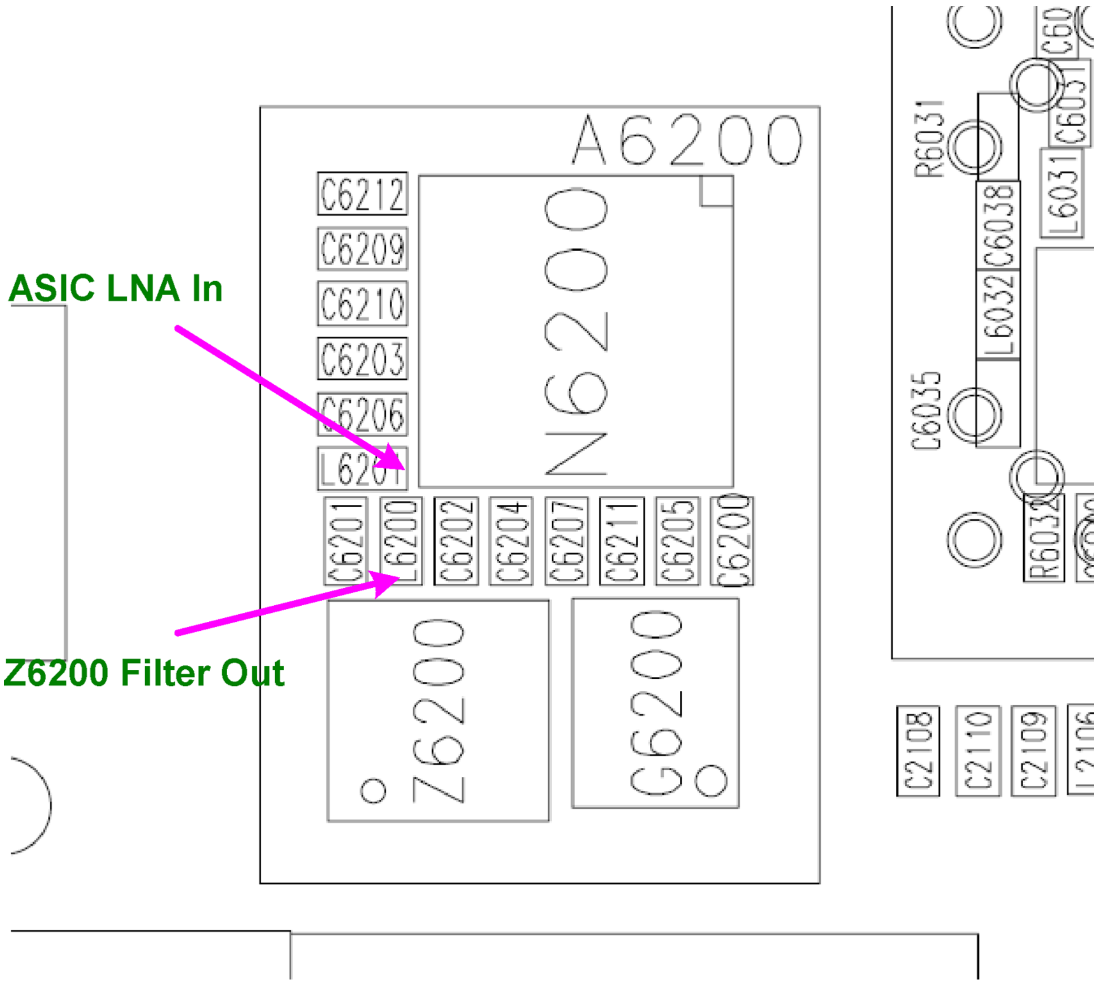

ASIC LNA In
Z6200 Filter Out
A6200
N6200
Z6200
G6200
C6212
C6209
C6210
C6203
C6206
L6201
C6201
L6200
C6202
C6204
C6207
C6211
C6205
C6200
R6031
C6035
C6038
L6032
L6031
R6032
C2108
C2110
C2109

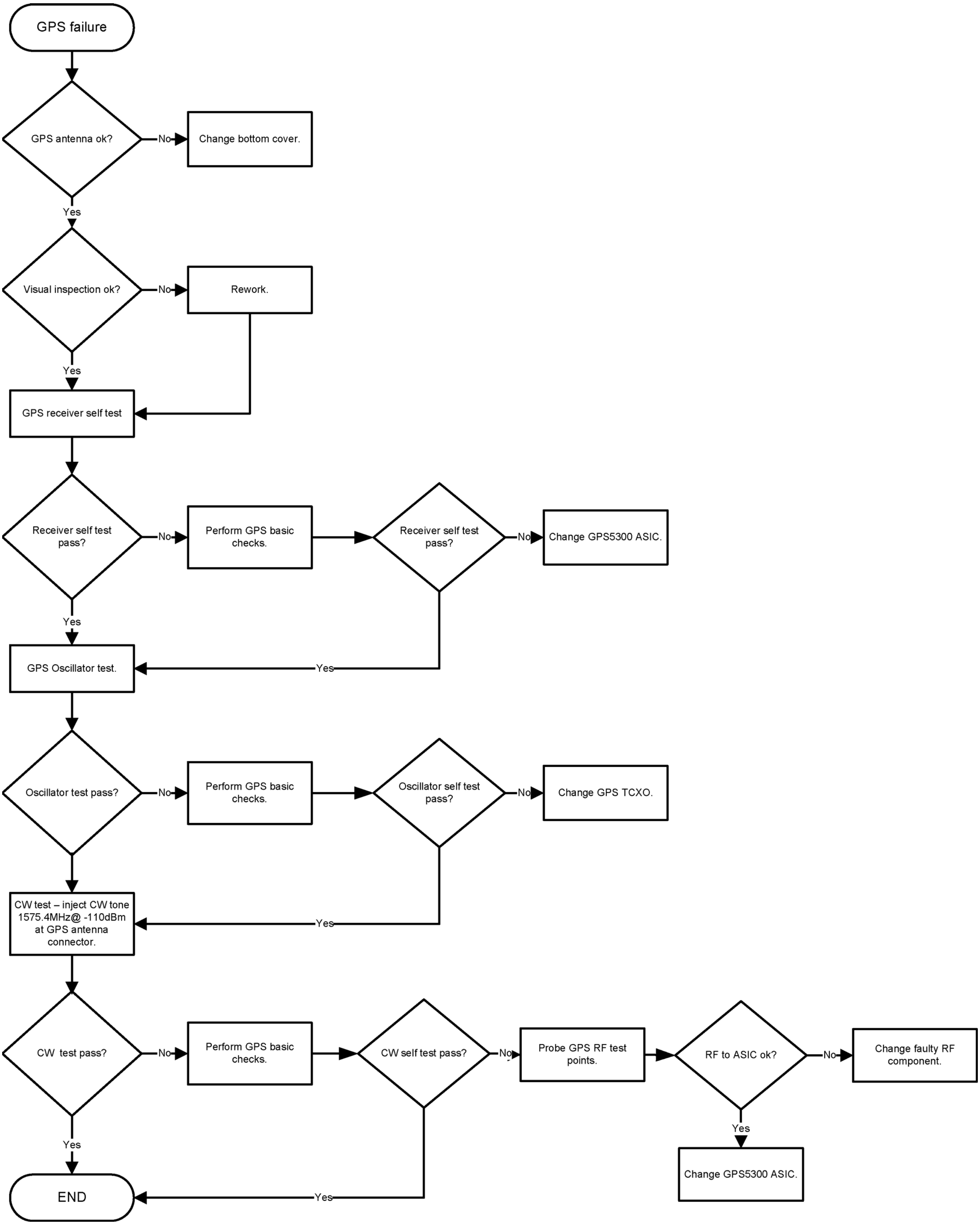
Figure 22 GPS RF probe points

GPS failure troubleshooting flow

Context

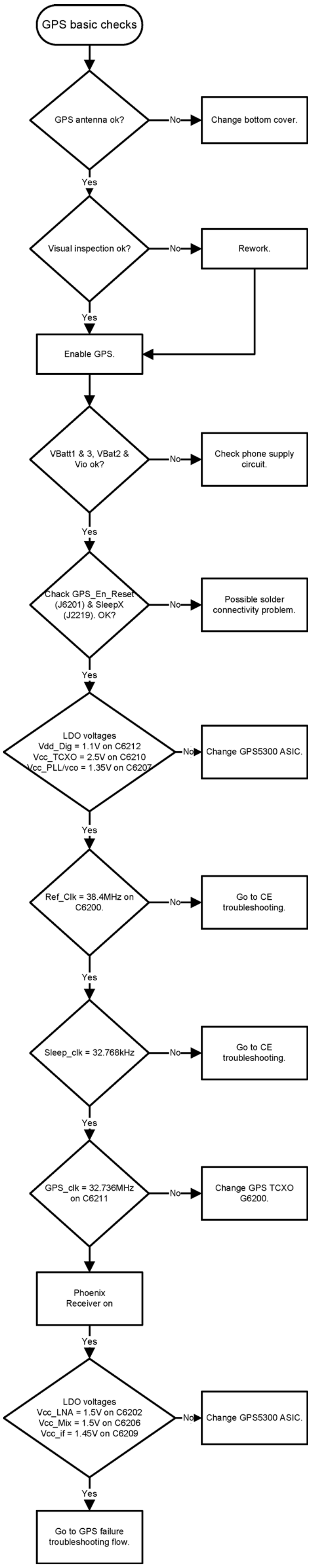
GPS troubleshooting is broken down into two parts: general GPS failure & GPS basic checks. The GPS failure troubleshooting flow can be followed and, where applicable, will feed into the Basic checks troubleshooting flow.

Troubleshooting flow


GPS failure
GPS antenna ok?
No
Change bottom cover.
Yes
Visual inspection ok?
No
Rework.
Yes
GPS receiver self test
Receiver self test pass?
No
Perform GPS basic checks.
Receiver self test pass?
No
Change GPS5300 ASIC.
Yes
Yes
GPS Oscillator test.
Oscillator test pass?
No
Perform GPS basic checks.
Oscillator self test pass?
No
Change GPS TCXO.
Yes
CW test – inject CW tone 1575.4MHz@ -110dBm at GPS antenna connector.
CW test pass?
No
Perform GPS basic checks.
CW self test pass?
No
Probe GPS RF test points.
RF to ASIC ok?
No
Change faulty RF component.
Yes
Change GPS5300 ASIC.
Yes
Yes
END

GPS basic checks troubleshooting flow

Troubleshooting flow


GPS basic checks
GPS antenna ok?
No
Change bottom cover.
Yes
Visual inspection ok?
No
Rework.
Yes
Enable GPS.
VBatt1 & 3, VBat2 & Vio ok?
No
Check phone supply circuit.
Yes
Chack GPS_En_Reset (J6201) & SleepX (J2219). OK?
No
Possible solder connectivity problem.
Yes
LDO voltages Vdd_Dig = 1.1V on C6212 Vcc_TCXO = 2.5V on C6210 Vcc_PLL/vco = 1.35V on C6207
No
Change GPS5300 ASIC.
Yes
Ref_Clk = 38.4MHz on C6200.
No
Go to CE troubleshooting.
Yes
Sleep_clk = 32.768kHz
No
Go to CE troubleshooting.
Yes
GPS_clk = 32.736MHz on C6211
No
Change GPS TCXO G6200.
Phoenix Receiver on
Yes
LDO voltages Vcc_LNA = 1.5V on C6202 Vcc_Mix = 1.5V on C6206 Vcc_if = 1.45V on C6209
No
Change GPS5300 ASIC.
Yes
Go to GPS failure troubleshooting flow.

Display module troubleshooting

General instructions for display troubleshooting

Context

- The display is in a normal mode when the phone is in active use.
- Display is in a partial idle mode when the phone is in the screen saver mode.
- The operating modes of the display can be controlled with the help of *Phoenix*.

Table 8 Display module troubleshooting cases

Display blank	There is no image on the display. The display looks the same when the phone is on as it does when the phone is off. The backlight can be on in some cases.
Image on the display not correct	Image on the display can be corrupted or a part of the image can be missing. If a part of the image is missing, change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram.
Backlight dim or not working at all	Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. This means that in case the display is working (image OK), the backlight is faulty.
Visual defects (pixel)	Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented the following table.

Table 9 Pixel defects

Item		White dot defect				Black dot defect	Total
1	Defect counts	R	G	B	White Dot Total	1	1
		1	1	1	1		
2	Combined defect counts	Not allowed. Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.					

Steps

1. Verify with a working display that the fault is not on the display module itself.

   The display module cannot be repaired.

2. Check that the cellular engine is working normally.

   i To check the functionality, connect the phone to a docking station.

   ii Start *Phoenix* service software.

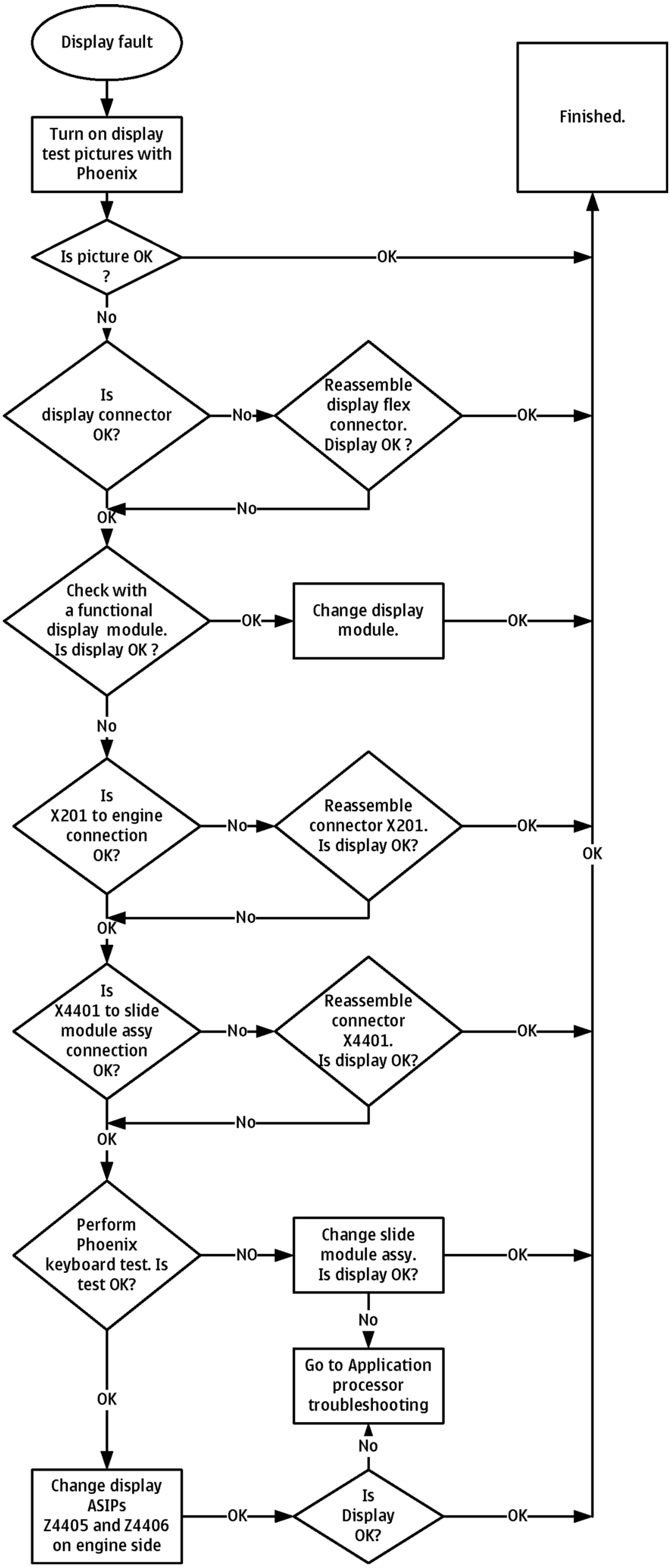
   iii Read the phone information to check that also the application engine is functioning normally (you should be able to read the APE ID).

3. Proceed to the display troubleshooting flowcharts.

   Use the **Display Test** tool in *Phoenix* to find the detailed fault mode.

Display troubleshooting

Troubleshooting flow


Display fault
Turn on display test pictures with Phoenix
Is picture OK ?
OK
No
Finished.
Is display connector OK?
No
Reassemble display flex connector. Display OK ?
OK
No
OK
Check with a functional display module. Is display OK ?
OK
Change display module.
OK
No
Is X201 to engine connection OK?
No
Reassemble connector X201. Is display OK?
OK
No
OK
OK
Is X4401 to slide module assy connection OK?
No
Reassemble connector X4401. Is display OK?
OK
No
OK
Perform Phoenix keyboard test. Is test OK?
NO
Change slide module assy. Is display OK?
OK
No
Go to Application processor troubleshooting
No
OK
Change display ASIPs Z4405 and Z4406 on engine side
OK
Is Display OK?
OK

Display and keyboard backlight troubleshooting

Context

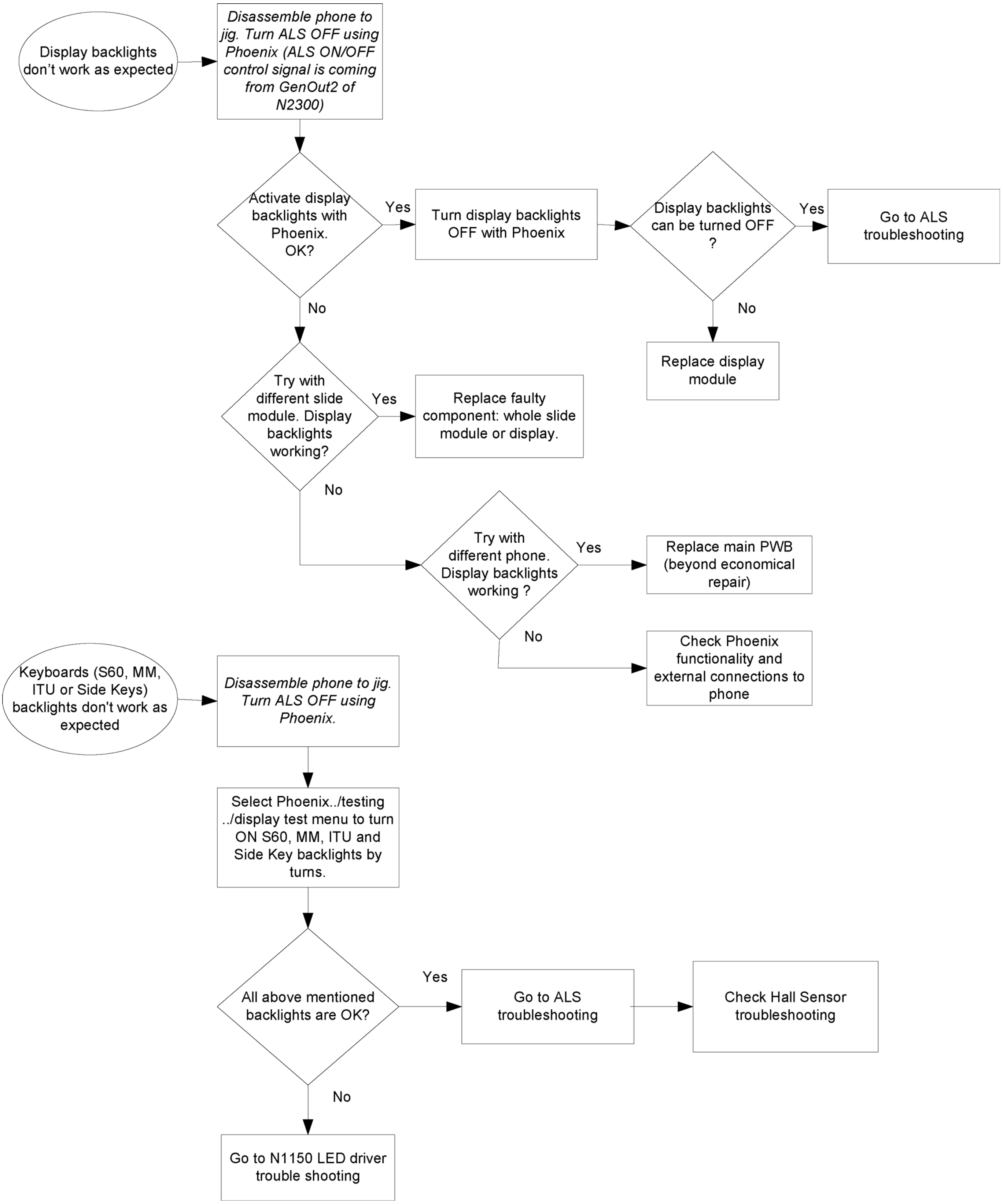
The device has one LED driver that provides current for both display and keyboard backlights and another LED driver that provides current for MM, ITU and side key backlights.

Keyboard backlights are turned ON only in dark conditions. This is controlled by the Ambient Light Sensor (ALS). Also the brightness of the display is adjusted by the ambient light sensor.

You can enable/disable ALS with the help of Phoenix service software.

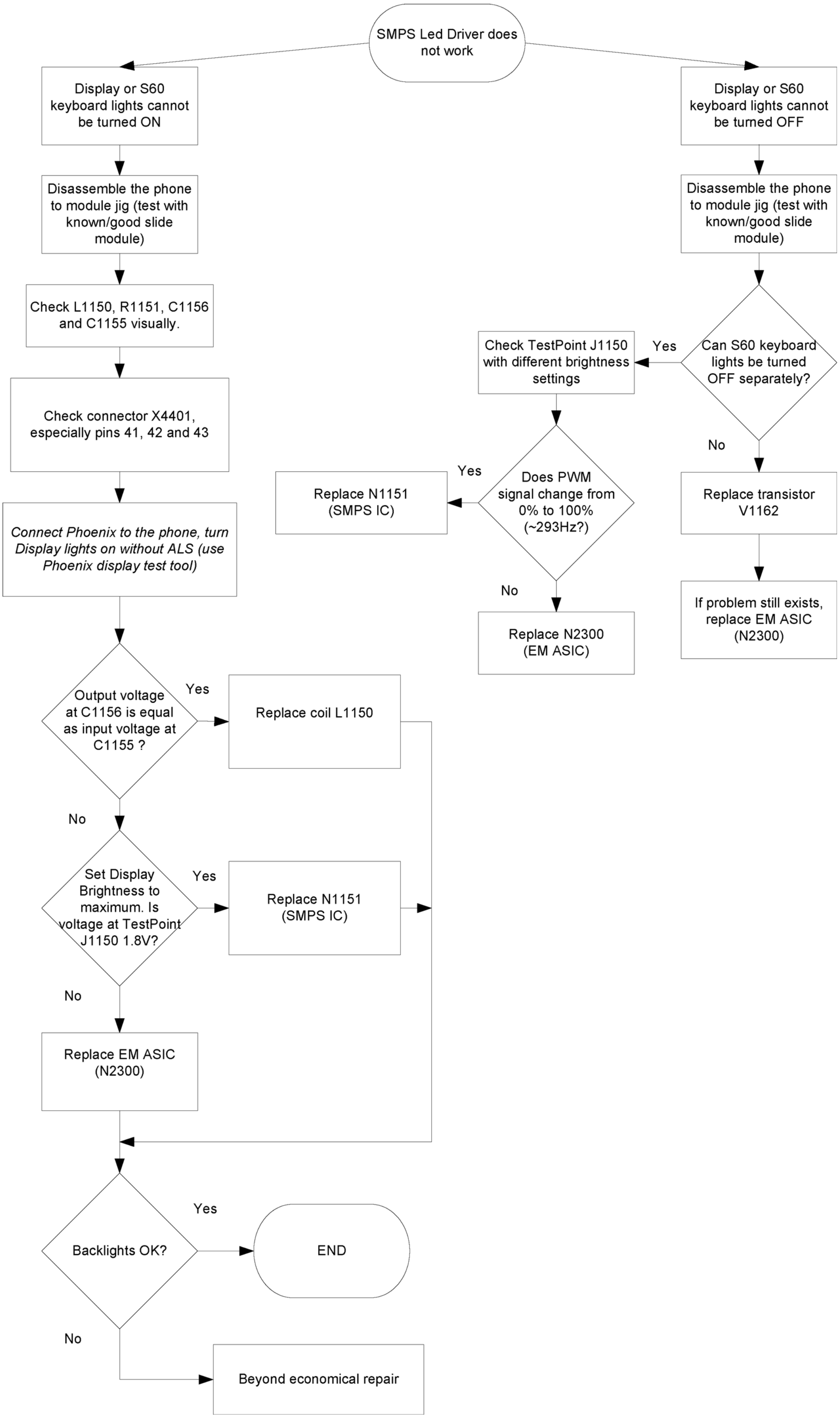
Display brightness can be adjusted manually, if ALS is disabled. If the ambient light sensor is enabled, it adjusts the display brightness automatically.

Troubleshooting flow


Display backlights don't work as expected
Disassemble phone to jig. Turn ALS OFF using Phoenix (ALS ON/OFF control signal is coming from GenOut2 of N2300)
Activate display backlights with Phoenix. OK?
Yes
Turn display backlights OFF with Phoenix
Display backlights can be turned OFF ?
Yes
Go to ALS troubleshooting
No
Replace display module
No
Try with different slide module. Display backlights working?
Yes
Replace faulty component: whole slide module or display.
No
Try with different phone. Display backlights working ?
Yes
Replace main PWB (beyond economical repair)
No
Check Phoenix functionality and external connections to phone
Keyboards (S60, MM, ITU or Side Keys) backlights don't work as expected
Disassemble phone to jig. Turn ALS OFF using Phoenix.
Select Phoenix../testing ../display test menu to turn ON S60, MM, ITU and Side Key backlights by turns.
All above mentioned backlights are OK?
Yes
Go to ALS troubleshooting
Check Hall Sensor troubleshooting
No
Go to N1150 LED driver trouble shooting

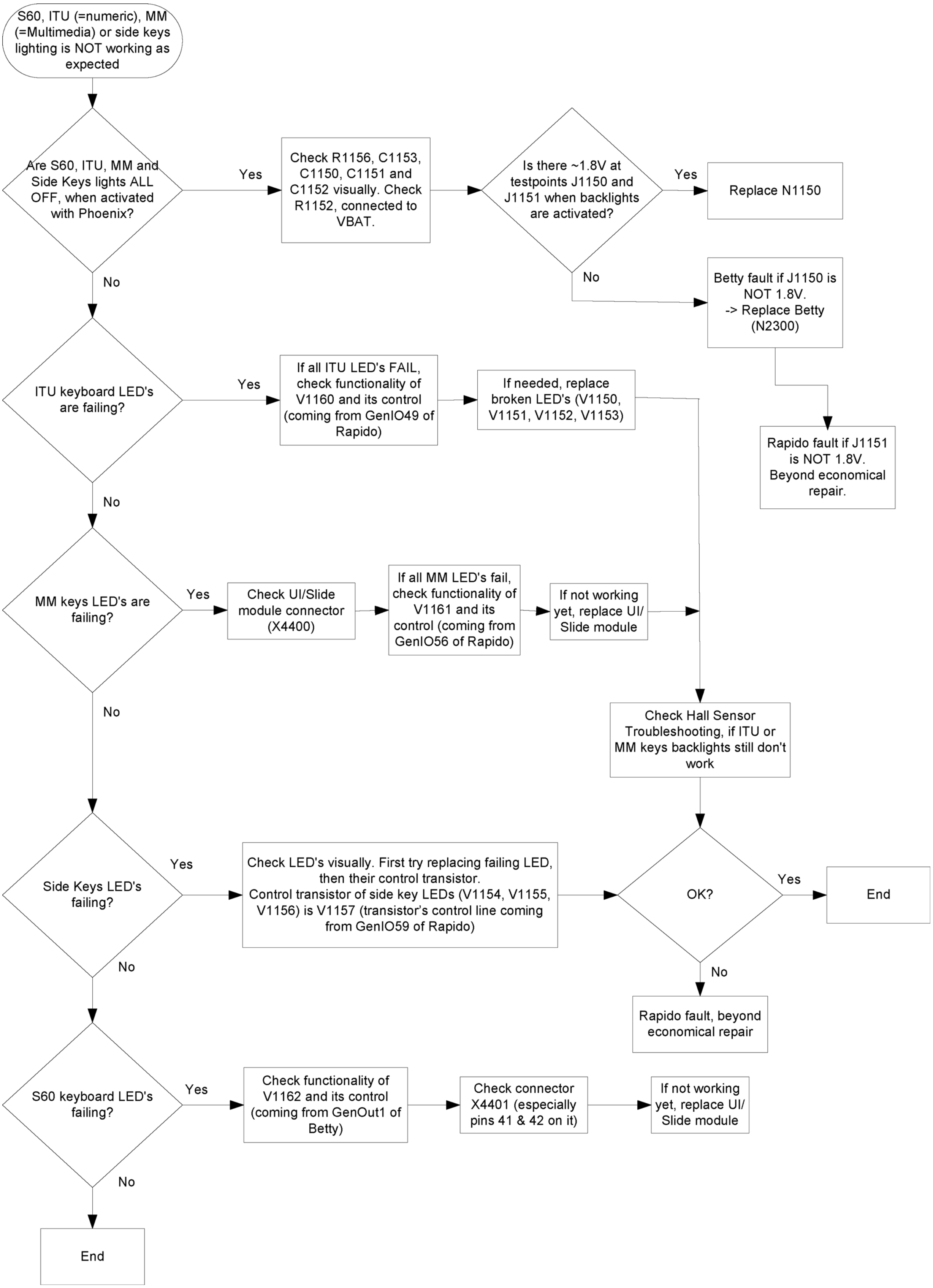
SMPS LED driver troubleshooting

Troubleshooting flow


SMPS Led Driver does not work
Display or S60 keyboard lights cannot be turned ON
Display or S60 keyboard lights cannot be turned OFF
Disassemble the phone to module jig (test with known/good slide module)
Check L1150, R1151, C1156 and C1155 visually.
Check connector X4401, especially pins 41, 42 and 43
Connect Phoenix to the phone, turn Display lights on without ALS (use Phoenix display test tool)
Output voltage at C1156 is equal as input voltage at C1155 ?
Yes
Replace coil L1150
No
Set Display Brightness to maximum. Is voltage at TestPoint J1150 1.8V?
Yes
Replace N1151 (SMPS IC)
No
Replace EM ASIC (N2300)
Backlights OK?
Yes
END
No
Beyond economical repair
Disassemble the phone to module jig (test with known/good slide module)
Can S60 keyboard lights be turned OFF separately?
Yes
Check TestPoint J1150 with different brightness settings
Does PWM signal change from 0% to 100% (~293Hz?)
Yes
Replace N1151 (SMPS IC)
No
Replace N2300 (EM ASIC)
No
Replace transistor V1162
If problem still exists, replace EM ASIC (N2300)

Current pump LED driver troubleshooting

Troubleshooting flow


S60, ITU (=numeric), MM (=Multimedia) or side keys lighting is NOT working as expected
Are S60, ITU, MM and Side Keys lights ALL OFF, when activated with Phoenix?
Yes
Check R1156, C1153, C1150, C1151 and C1152 visually. Check R1152, connected to VBAT.
Is there ~1.8V at testpoints J1150 and J1151 when backlights are activated?
Yes
Replace N1150
No
Betty fault if J1150 is NOT 1.8V. -> Replace Betty (N2300)
Rapido fault if J1151 is NOT 1.8V. Beyond economical repair.
No
ITU keyboard LED's are failing?
Yes
If all ITU LED's FAIL, check functionality of V1160 and its control (coming from GenIO49 of Rapido)
If needed, replace broken LED's (V1150, V1151, V1152, V1153)
No
MM keys LED's are failing?
Yes
Check UI/Slide module connector (X4400)
If all MM LED's fail, check functionality of V1161 and its control (coming from GenIO56 of Rapido)
If not working yet, replace UI/ Slide module
Check Hall Sensor Troubleshooting, if ITU or MM keys backlights still don't work
No
Side Keys LED's failing?
Yes
Check LED's visually. First try replacing failing LED, then their control transistor. Control transistor of side key LEDs (V1154, V1155, V1156) is V1157 (transistor's control line coming from GenIO59 of Rapido)
OK?
Yes
End
No
Rapido fault, beyond economical repair
No
S60 keyboard LED's failing?
Yes
Check functionality of V1162 and its control (coming from GenOut1 of Betty)
Check connector X4401 (especially pins 41 & 42 on it)
If not working yet, replace UI/ Slide module
No
End

Ambient Light Sensor (ALS) troubleshooting

Context

- If ALS (Poliwag) is broken, replace the whole slide module (which includes new ALS).
- After replacing the ALS, ALS re-tuning is required for example if calibration values of the new sensor are lost (see instructions later in this document).
- When carrying out the ALS calibration procedure, it is required to have a reference phone, which includes calibrated ALS. ALS re-tuning instructions below explain why the reference phone is needed.
- Make sure that you have completed Display and keyboard backlight troubleshooting (page 3–45) first before starting **ALS troubleshooting**.

Here are some hints for ALS troubleshooting:

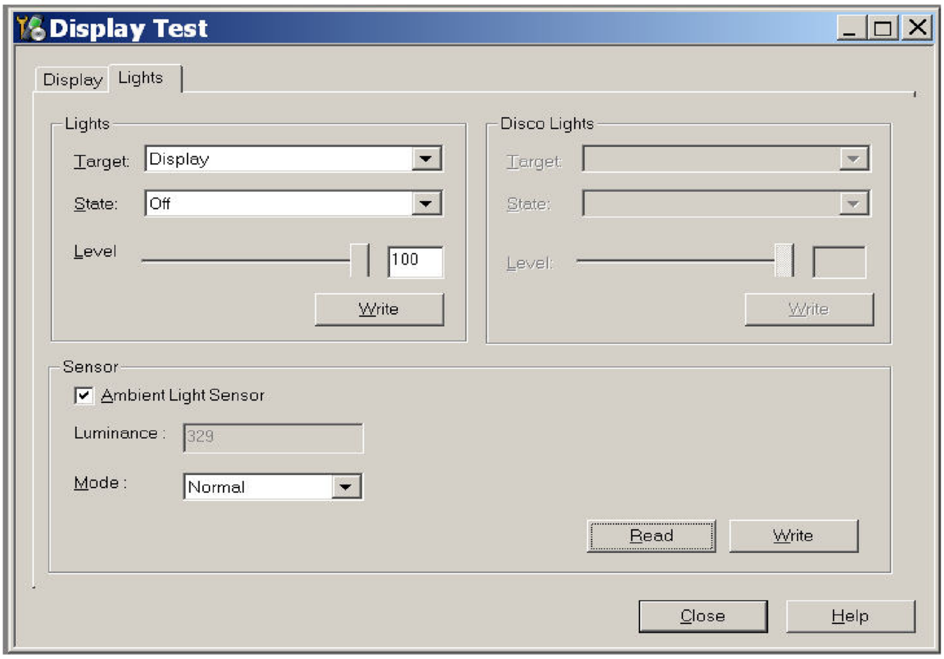
- In *Phoenix* Display Test tool, there is an*Ambient Light Sensor* window, which shows the luminance. The correct luminance in darkness is <20 lx, and in office environment 100-2000 lx. The luminance value depends strongly on the light source and the angle of the phone, so these values are only a rough guideline.
- LED drivers' control voltage measurement points can be found in the SMPS LED drivers troubleshooting (page 3–47) and Current pump LED driver troubleshooting (page 3–48) sections. When backlight brightness is set to 100%, the PWM signal is continuously on high state.
- *Phoenix* has an ambient light sensor calibration tool for changing calibration values. Concerning Poliwag ALS, there is no need for performing a pull-up resistor calibration (as for earlier Ambient Light Sensors).

Re-tune Poliwag ALS as follows:

Steps

1. Connect the reference phone to *Phoenix* and set the phone (e.g. on the table) so that the amount of ambient light is as stabile as possible seen by Poliwag ALS. Light guide of the ALS is located in the upper part of the phone's A-Cover.
2. Start *Phoenix*.
3. Choose **File→Scan Product.**
4. Choose **Testing→Display Test.**

   You should see the following window:


Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Sensor
Read
Write
Close
Help

Target: Display

State: Off

Level 100

☑ Ambient Light Sensor

Luminance : 329

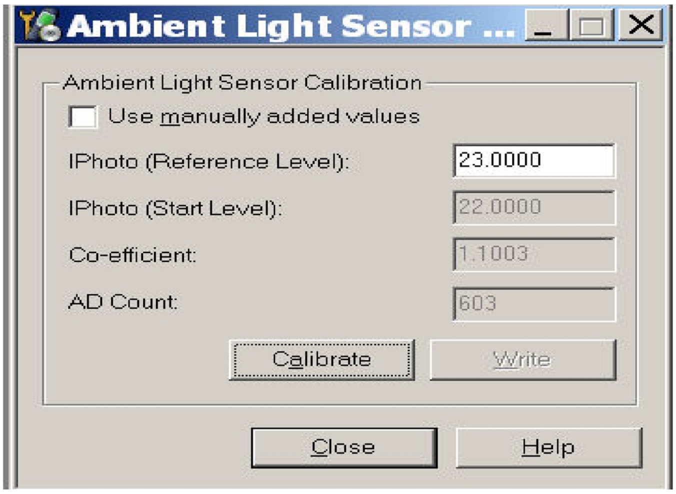
Mode : Normal

Figure 23 *Ambient Light Sensor Calibration* window

Open the **Lights** tab, check the **Ambient Light Sensor** check box, Click **Read** to get reference ambient light value from the **Luminance** text box and write it down.

5. Repeat steps 1 to 4 to calibrate the phone and make sure the phone to be calibrated is located in the same place as the reference phone was when luminance reading was taken. Write down the illuminance of the phone to be calibrated.
6. Calculate the co-efficient from the reference and the phone to be calibrated luminance values by division: Co-efficient = luminance (reference phone) / luminance (phone to be calibrated), write down the calculated co-efficient value.
7. Choose **Tuning→Ambient Light Sensor Calibration** .

   You should see the following window:


Ambient Light Sensor ...
Ambient Light Sensor Calibration
Calibrate
Write
Close
Help

☐ Use manually added values

IPhoto (Reference Level): 23.0000

IPhoto (Start Level): 22.0000

Co-efficient: 1.1003

AD Count: 603

Iterate by changing **IPhoto** (reference level) value (remove cross from **Use manually added values**). After writing a value to **IPhoto** (reference value), press the **Calibrate** button. Stop iterating when the co-efficient is equal to the co-efficient calculated in bullet 6. Note that decimal numbers should be used in the iteration in order to achieve enough precision (e.g 23.2455).

8. After having a co-efficient value in the **Co-efficient** textbox as the calculated value, make sure that ambient light values (read using **TestingDisplay TestLuminance** textbox) are almost the same in the reference phone and the calibrated phone. Remember that illuminance readings for the reference and calibrated phones must be done in the same ambient light conditions. If illuminance values differ a lot (difference max. +- 10%), repeat the ALS re-tuning procedure from the beginning.
9. To end the calibration, click **Close**.

Backlights controlling in Phoenix

Backlights controlling in Phoenix

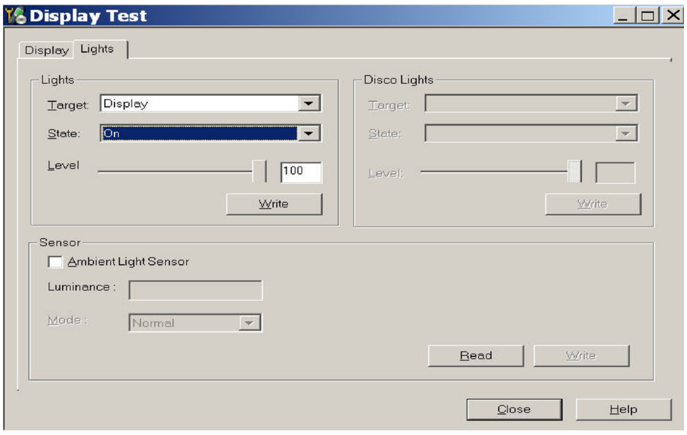
There are two power sources for lights. One is an SMPS type LED driver giving about 16V out, when 4 LEDs are connected as serial between its output and GND. Output is shared to two branches (4 + 4 LEDs in serial). This SMPS type LED driver is used for powering the display and S60 keyboard lights. Display lights must be switched ON before it is possible to switch ON S60 keybord lights. However, S60 keyboard lights can be switched OFF, although display lights are still ON.

The second LED driver (a current pump type driver) is used for powering all other LEDs (ITU keyboard, MM keys and side keys lights). This driver includes seven outputs. Each LED is connected straight from driver output to GND. Different keybord lighting groups can be switched ON/OFF separately. In addition to that, it is possible to switch ON/OFF every side key light independently.

Switching display lighting on using Phoenix

Steps

1. Connect phone to *Phoenix*.
2. Start *Phoenix*.
3. Choose **File Scan Product**.
4. Choose **Display Display test**.
5. Click the **Lights** sheet.



Target: Display
State: On
Level 100

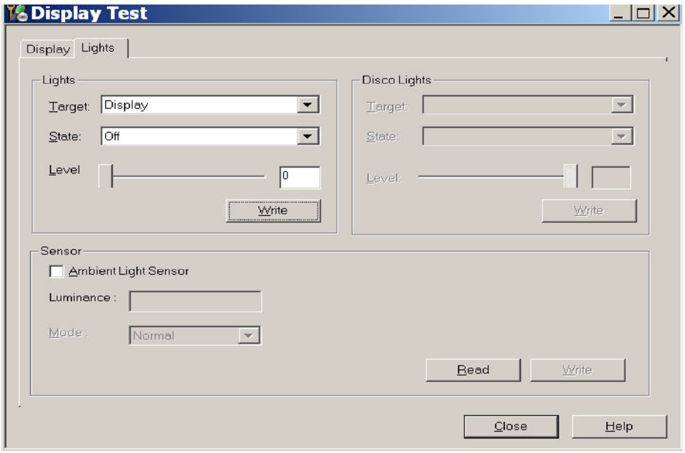
6. From **Target** partition, select **Display**.
7. From **State** partition, select **On**.
8. Set **Level** to **100** and click **Write**.
9. Click **Close** to end the lights testing.

Note: It is possible to set any value between 0...100 for display lights.

Switching display lighting OFF using Phoenix

Prerequisites

First, go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51), if not done yet



Display Test

Lights

Target: Display

State: Off

Level: 0

☐ Ambient Light Sensor

Display
Lights
Write
Disco Lights
Target:
State:
Level
Write
Sensor
Luminance :
Mode :
Normal
Read
Write
Close
Help

Steps

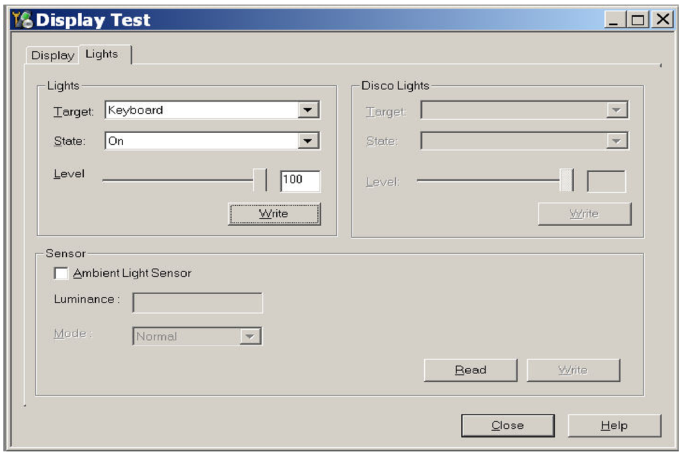
1. From **Target** partition, select **Display**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Switching S60 keyboard lighting ON using Phoenix

Prerequisites

First, go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51), if not done yet.

> **Note:** It is not possible to switch S60 keyboard lighting ON if display lighting is not activated (all other keyboard lights can be activated, although display lights would be OFF, but not S60 keyboard lights).



Display Test

Lights

Target: Keyboard

State: On

Level: 100

☐ Ambient Light Sensor

Display
Lights
Write
Disco Lights
Target:
State:
Level
Write
Sensor
Luminance :
Mode :
Normal
Read
Write
Close
Help

Steps

1. From **Target** partition, select **Keyboard**.

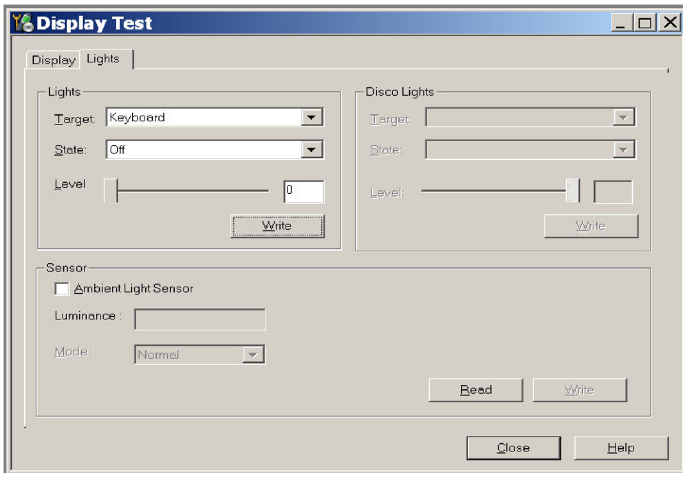
2. From **State** partition, select **On**.
3. Set **Level** to **100** and click **Write**.
4. Click **Close** to end the lights testing.

> **Note:** The S60 keyboard lighting brightness follows display lighting brightness value, i.e. it is not possible to set different brightness for display and S60 keyboard lighting.

Switching S60 keyboard lighting OFF using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Target: Keyboard
State: Off
Level 0

Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Write
Sensor
Ambient Light Sensor
Luminance :
Mode :
Normal
Read
Write
Close
Help

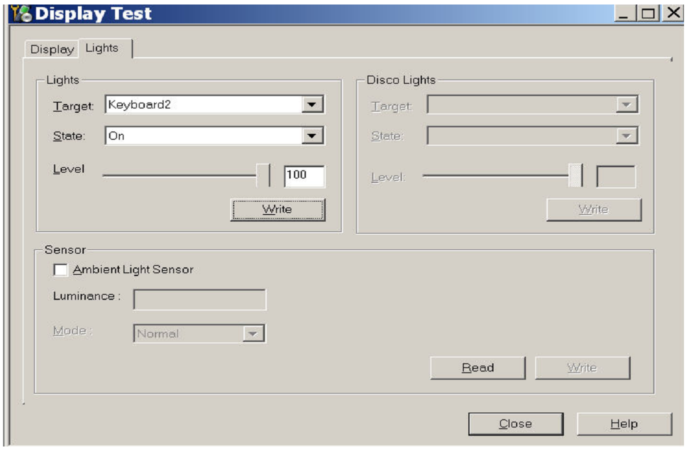
Steps

1. From **Target** partition, select **Keyboard**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Switching ITU (numeric) keyboard lighting ON using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Target: Keyboard2
State: On
Level 100

Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Write
Sensor
Ambient Light Sensor
Luminance :
Mode :
Normal
Read
Write
Close
Help

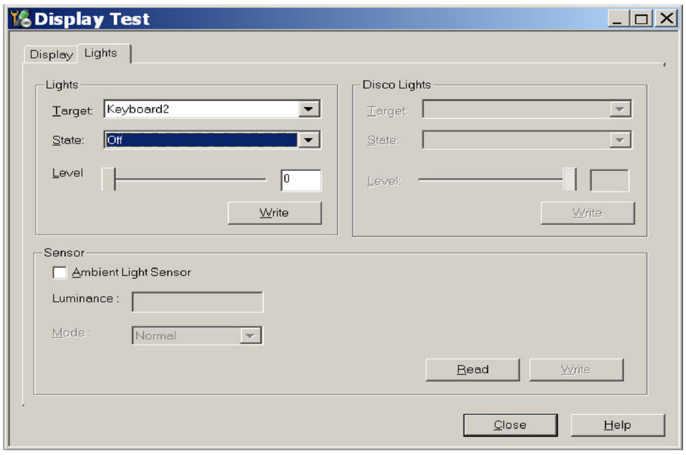
Steps

1. From **Target** partition, select **Keyboard2**.
2. From **State** partition, select **On**.
3. Set **Level** to **100** and click **Write**.
4. Click **Close** to end the lights testing.

Switching ITU (numeric) keyboard lighting OFF using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Target: Keyboard2
State: Off
Level: 0
Mode: Normal

Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Sensor
☐ Ambient Light Sensor
Luminance :
Read
Write
Close
Help

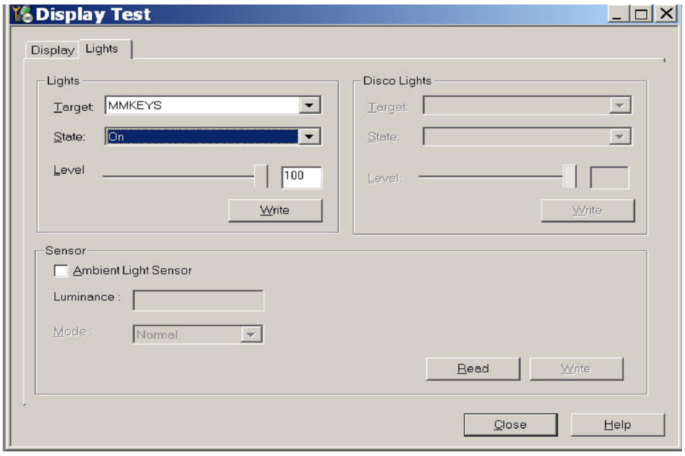
Steps

1. From **Target** partition, select **Keyboard2**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Switching MM (multimedia) keys lighting ON using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Target: MMKEYS
State: On
Level: 100
Mode: Normal

Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Sensor
☐ Ambient Light Sensor
Luminance :
Read
Write
Close
Help

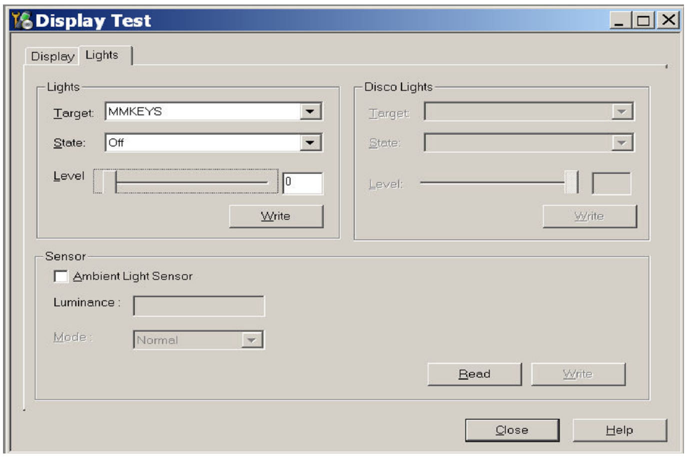
Steps

1. From **Target** partition, select **MMKEYS**.
2. From **State** partition, select **On**.
3. Set **Level** to **100** and click **Write**.
4. Click **Close** to end the lights testing.

Switching MM (multimedia) keys lighting OFF using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Target: MMKEYS
State: Off
Level 0

Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Write
Sensor
☐ Ambient Light Sensor
Luminance :
Mode : Normal
Read
Write
Close
Help

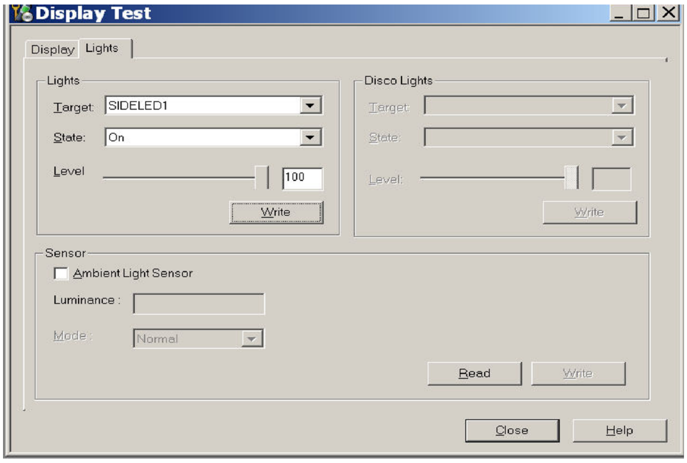
Steps

1. From **Target** partition, select **MMKEYS**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Switching volume keys lighting ON using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Target: SIDELED1
State: On
Level 100

Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Write
Sensor
☐ Ambient Light Sensor
Luminance :
Mode : Normal
Read
Write
Close
Help

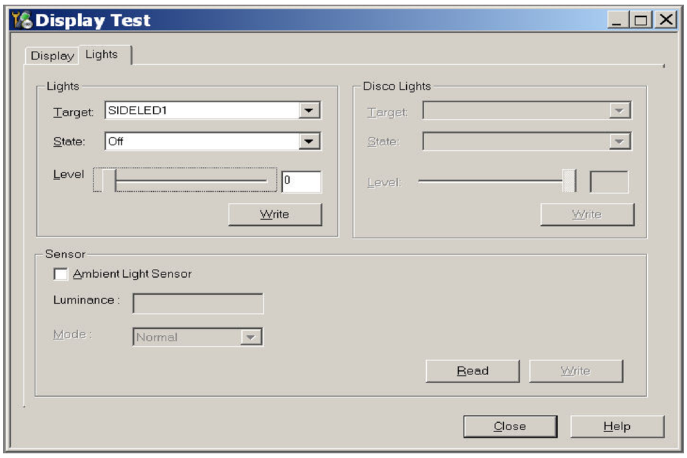
Steps

1. From **Target** partition, select **SIDELED1**.
2. From **State** partition, select **On**.
3. Set **Level** to **100** and click **Write**.
4. Click **Close** to end the lights testing.

Switching volume keys lighting OFF using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Display Test

Target: SIDELED1

State: Off

Level: 0

Display
Lights
Lights
Write
Disco Lights
Target:
State:
Level:
Write
Sensor
Ambient Light Sensor
Luminance :
Mode :
Normal
Read
Write
Close
Help

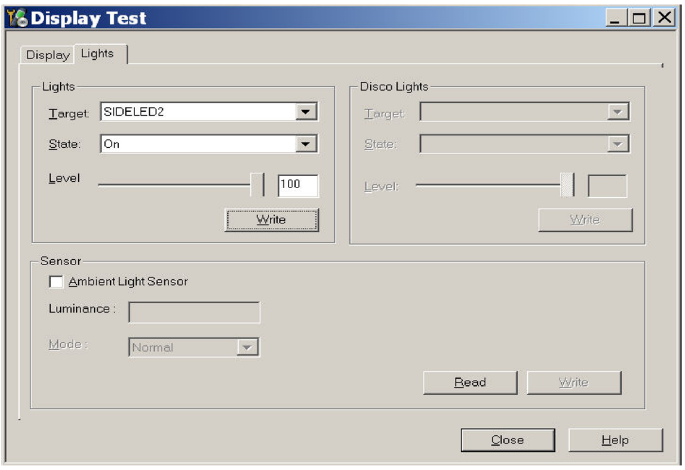
Steps

1. From **Target** partition, select **SIDELED1**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Switch imaging key lighting ON using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Display Test

Target: SIDELED2

State: On

Level: 100

Display
Lights
Lights
Write
Disco Lights
Target:
State:
Level:
Write
Sensor
Ambient Light Sensor
Luminance :
Mode :
Normal
Read
Write
Close
Help

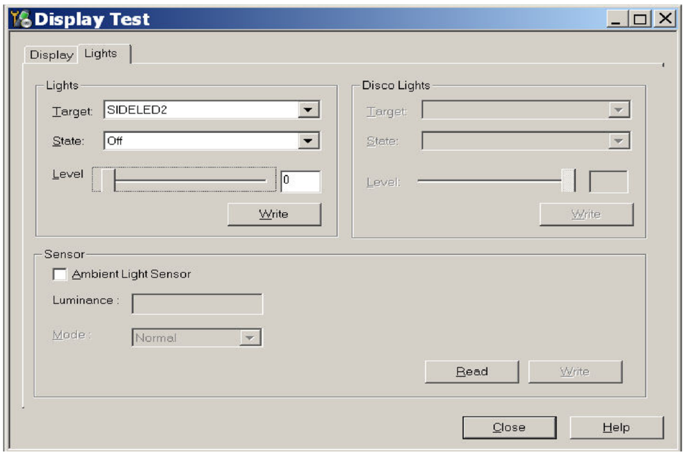
Steps

1. From **Target** partition, select **SIDELED2**.
2. From **State** partition, select **On**.
3. Set **Level** to **100** and click **Write**.
4. Click **Close** to end the lights testing.

Switching imaging key lighting OFF using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.


Display Test
Display
Lights
Disco Lights
Write
Sensor
☐ Ambient Light Sensor
Luminance :
Read
Write
Close
Help

Target: SIDELED2
State: Off
Level: 0
Mode: Normal

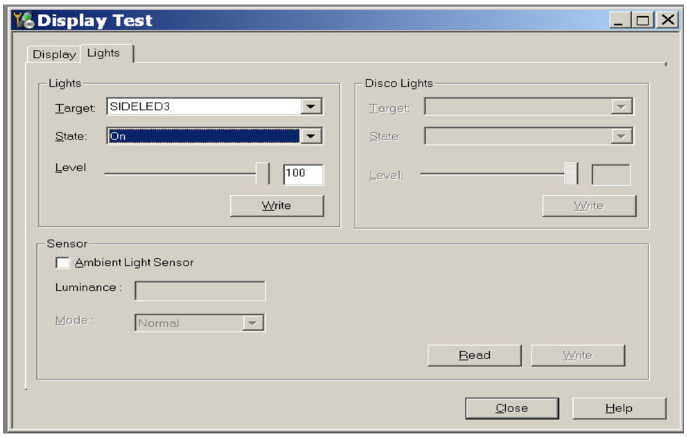
Steps

1. From **Target** partition, select **SIDELED2**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Switching shutter key lighting ON using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.


Display Test
Display
Lights
Disco Lights
Write
Sensor
☐ Ambient Light Sensor
Luminance :
Read
Write
Close
Help

Target: SIDELED3
State: On
Level: 100
Mode: Normal

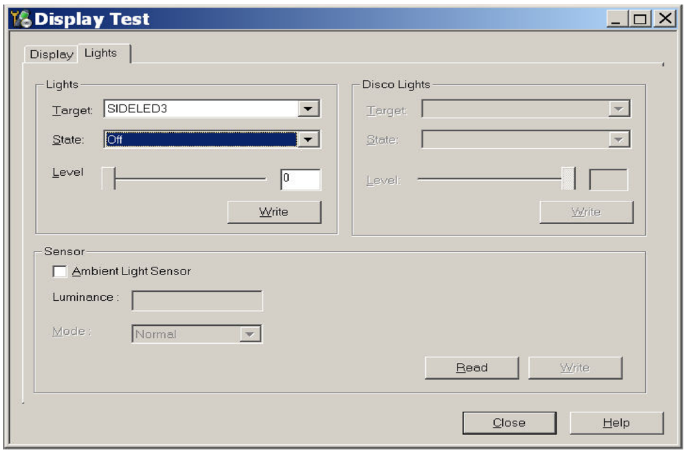
Steps

1. From **Target** partition, select **SIDELED3**.
2. From **State** partition, select **On**.
3. Set **Level** to **100** and click **Write**.
4. Click **Close** to end the lights testing.

Switching shutter key lighting OFF using Phoenix

Prerequisites

First go through steps 1-5 in Switching display lighting ON using Phoenix (page 3–51) if not done yet.



Display Test

Lights

Target: SIDELED3

State: Off

Level: 0

Steps

1. From **Target** partition, select **SIDELED3**.
2. From **State** partition, select **Off**.
3. Set **Level** to **0** and click **Write**.
4. Click **Close** to end the lights testing.

Bluetooth troubleshooting

Introduction to Bluetooth troubleshooting

There are two main Bluetooth problems that can occur:

Problem	Description
Detachment of the BT antenna.	This would most likely happen if the device has been dropped repeatedly to the ground. It could cause the BT antenna to become loose or partially detached from the PWB. (see next page for details about BT antenna HW and Mechanics)
A malfunction in the BT ASIC, BB ASICs or Phone's BT SMD components.	This is unpredictable and could have many causes i.e. SW or HW related.

The main issue is to find out if the problem is related to the BT antenna or related to the BT system or the phone's BB and then replace/fix the faulty component.

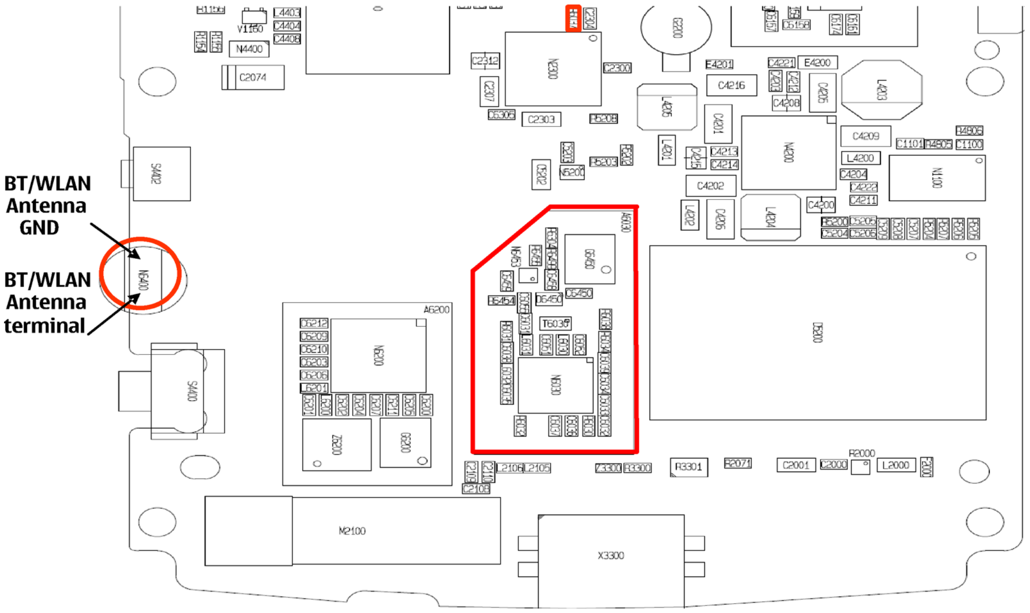

BT/WLAN Antenna GND
BT/WLAN Antenna terminal
N6400
S4402
S4400
N6200
M2100
X3300
N6300
N2300
N4200
N1100
D2000
A6200

Figure 24 Bluetooth placement on the bottom side

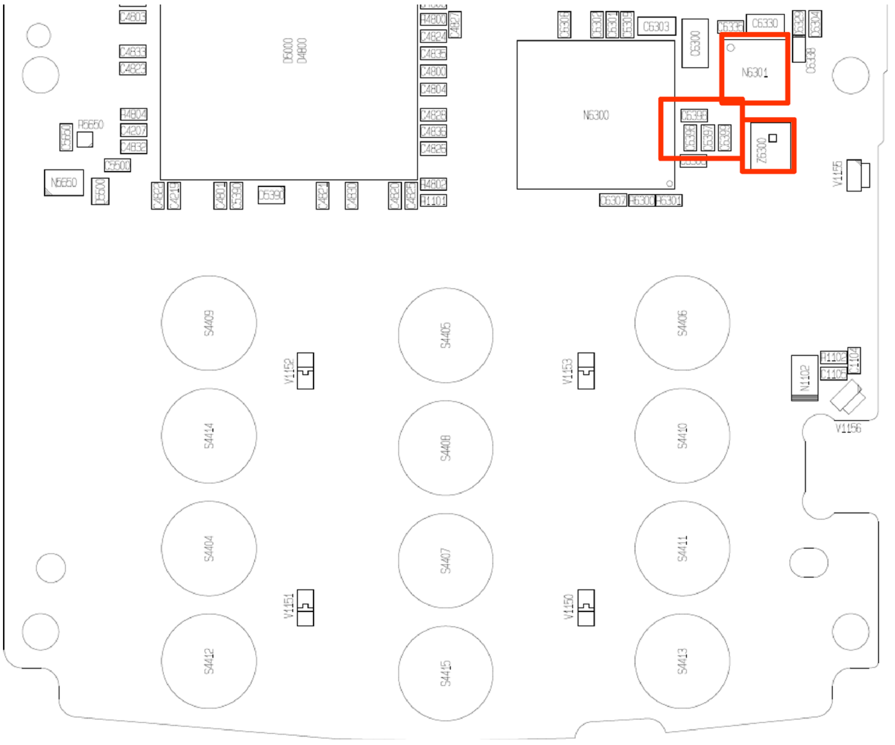

N6300
N6301
Z6300
D4800
N5650
S4409
S4405
S4406
S4414
S4408
S4410
S4404
S4407
S4411
S4412
S4415
S4413
V1152
V1153
V1151
V1150
V1155
V1156
N1102

Figure 25 Bluetooth placement on the top side

Bluetooth settings for Phoenix

Steps

1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing→Bluetooth LOCALS** .

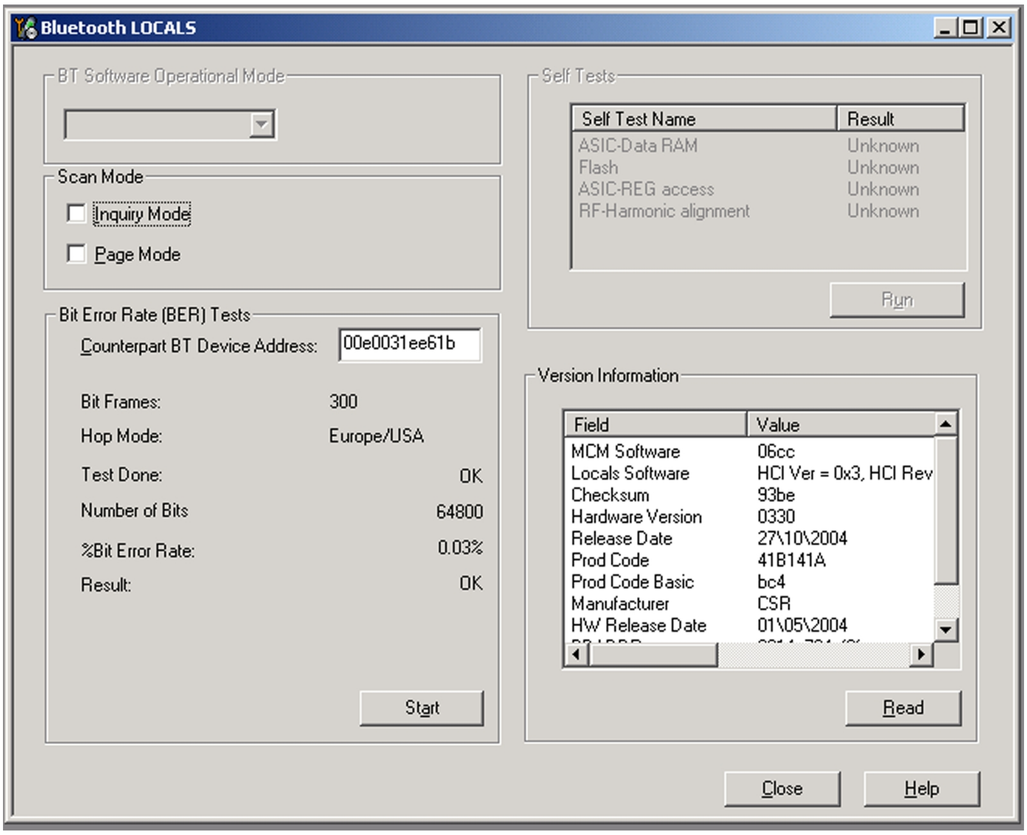
5. Locate JBT-9’s serial number (12 digits) found in the type label on the back of JBT-9.

   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.

   This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.



☐ Inquiry Mode
☐ Page Mode

Counterpart BT Device Address: 00e0031ee61b

Bit Frames: 300
Hop Mode: Europe/USA
Test Done: OK
Number of Bits 64800
%Bit Error Rate: 0.03%
Result: OK

Self Test Name	Result
ASIC-Data RAM	Unknown
Flash	Unknown
ASIC-REG access	Unknown
RF-Harmonic alignment	Unknown

Field	Value
MCM Software	06cc
Locals Software	HCI Ver = 0x3, HCI Rev
Checksum	93be
Hardware Version	0330
Release Date	27\10\2004
Prod Code	41B141A
Prod Code Basic	bc4
Manufacturer	CSR
HW Release Date	01\05\2004

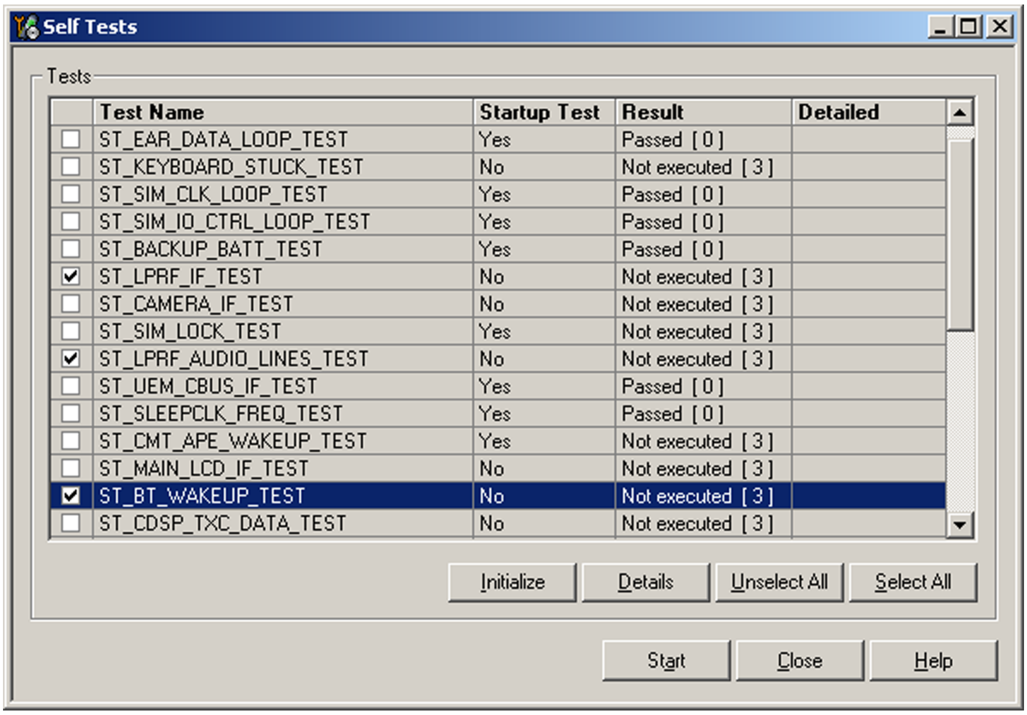
Figure 26 BER test result

Bluetooth self tests in Phoenix

Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**

7. To run the tests, click **Start**.

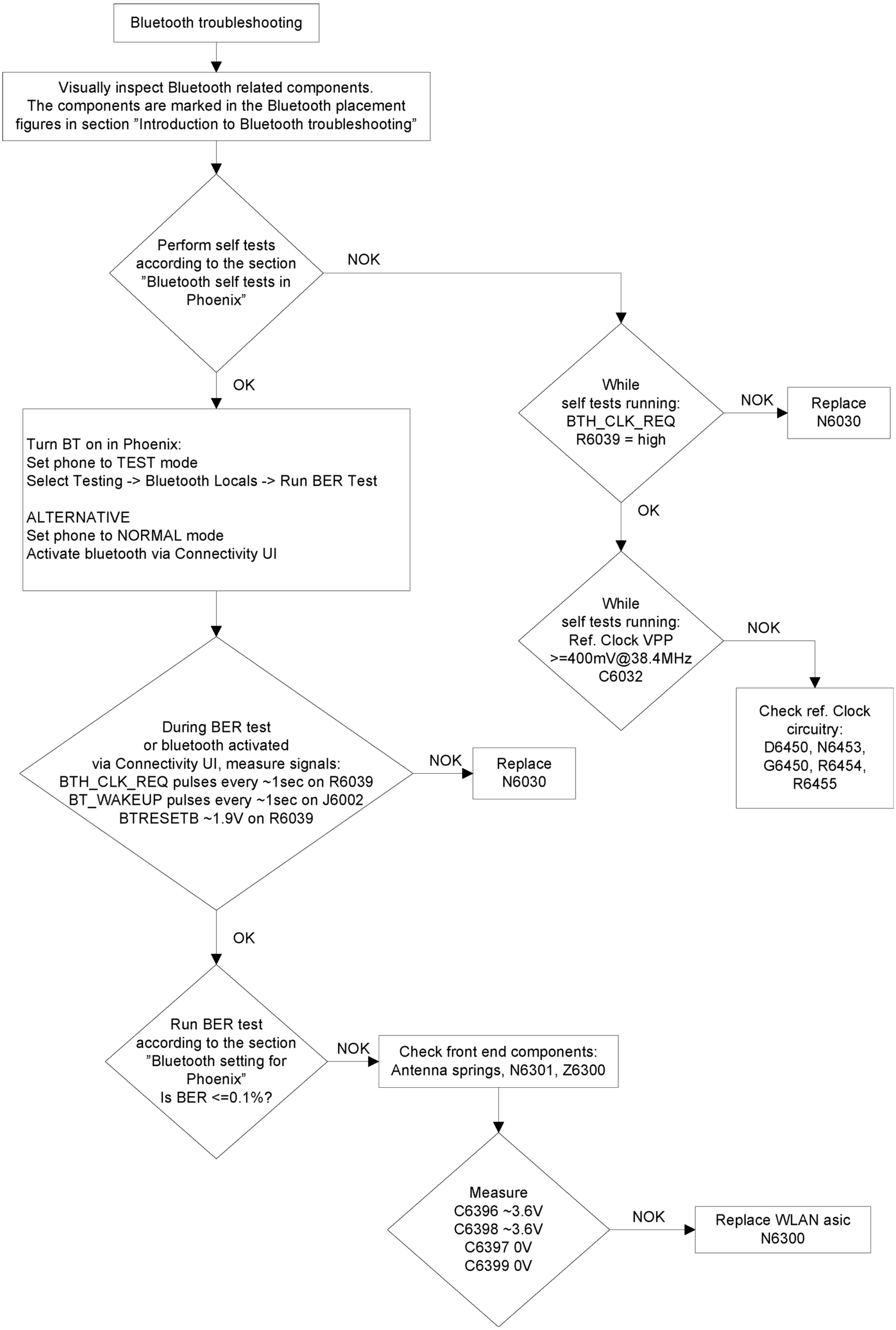


	Test Name	Startup Test	Result	Detailed
☐	ST_EAR_DATA_LOOP_TEST	Yes	Passed [0]	
☐	ST_KEYBOARD_STUCK_TEST	No	Not executed [3]	
☐	ST_SIM_CLK_LOOP_TEST	Yes	Passed [0]	
☐	ST_SIM_IO_CTRL_LOOP_TEST	Yes	Passed [0]	
☐	ST_BACKUP_BATT_TEST	Yes	Passed [0]	
☑	ST_LPRF_IF_TEST	No	Not executed [3]	
☐	ST_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_SIM_LOCK_TEST	Yes	Not executed [3]	
☑	ST_LPRF_AUDIO_LINES_TEST	No	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_SLEEPCLK_FREQ_TEST	Yes	Passed [0]	
☐	ST_CMT_APE_WAKEUP_TEST	Yes	Not executed [3]	
☐	ST_MAIN_LCD_IF_TEST	No	Not executed [3]	
☑	ST_BT_WAKEUP_TEST	No	Not executed [3]	
☐	ST_CDSP_TXC_DATA_TEST	No	Not executed [3]	

Figure 27 Bluetooth self tests in *Phoenix*

Bluetooth troubleshooting

Troubleshooting flow


Bluetooth troubleshooting
Visually inspect Bluetooth related components. The components are marked in the Bluetooth placement figures in section "Introduction to Bluetooth troubleshooting"
Perform self tests according to the section "Bluetooth self tests in Phoenix"
NOK
OK
While self tests running: BTH_CLK_REQ R6039 = high
NOK
Replace N6030
OK
While self tests running: Ref. Clock VPP >=400mV@38.4MHz C6032
NOK
Check ref. Clock circuitry: D6450, N6453, G6450, R6454, R6455
Turn BT on in Phoenix:
Set phone to TEST mode
Select Testing -> Bluetooth Locals -> Run BER Test
ALTERNATIVE
Set phone to NORMAL mode
Activate bluetooth via Connectivity UI
During BER test or bluetooth activated via Connectivity UI, measure signals: BTH_CLK_REQ pulses every ~1sec on R6039 BT_WAKEUP pulses every ~1sec on J6002 BTRESETB ~1.9V on R6039
NOK
Replace N6030
OK
Run BER test according to the section "Bluetooth setting for Phoenix" Is BER <=0.1%?
NOK
Check front end components: Antenna springs, N6301, Z6300
Measure C6396 ~3.6V C6398 ~3.6V C6397 0V C6399 0V
NOK
Replace WLAN asic N6300

Audio troubleshooting

Audio paths

Earpiece is driven directly by a built-in linear power amplifier included in the EM ASIC N2200 ASIC. The output has a differential output configuration. Signal lines are biased by the EM ASIC N2200.

Vibra is driven directly by a built-in digital pulse modulated amplifier included in the EM ASIC N2200 ASIC. The output has a differential output configuration.

Nokia AV stereo output is driven by a discrete stereo headphone amplifier that is connected to the balanced outputs of the EM ASIC N2200 ASIC (shared output with the discrete stereo speaker amplifier). The discrete stereo headphone output has a single-ended ground reference output.

Stereo speakers are driven by a discrete digital stereo speaker amplifier that is connected to the balanced outputs of the EM ASIC N2200 (shared output with the discrete stereo headphone amplifier). The discrete stereo speaker amplifier has a differential output configuration.

Internal microphone is connected directly to the single-ended input of the EM ASIC N2200. Signal line is biased by the EM ASIC N2200.

Nokia AV mono input is connected to the EM ASIC N2200 single-ended input via two switches: data-switch and video-switch. The input is biased by the EM ASIC N2200.

Audio loop test

Audio paths can be tested via built-in audio loop test routine. To test a specific audio path, an electrical test signal can be fed into the mono input of the Nokia AV-connector and looped to specified audio output: earpiece, stereo speakers or the Nokia AV stereo output. Similarly, an acoustical or an electrical test signal can be fed into the internal microphone and looped to the Nokia AV stereo output. Loop routines can be initiated using the audio test interface in the Phoenix service program.

Vibra can be tested by dedicated vibra test in the Phoenix service program.

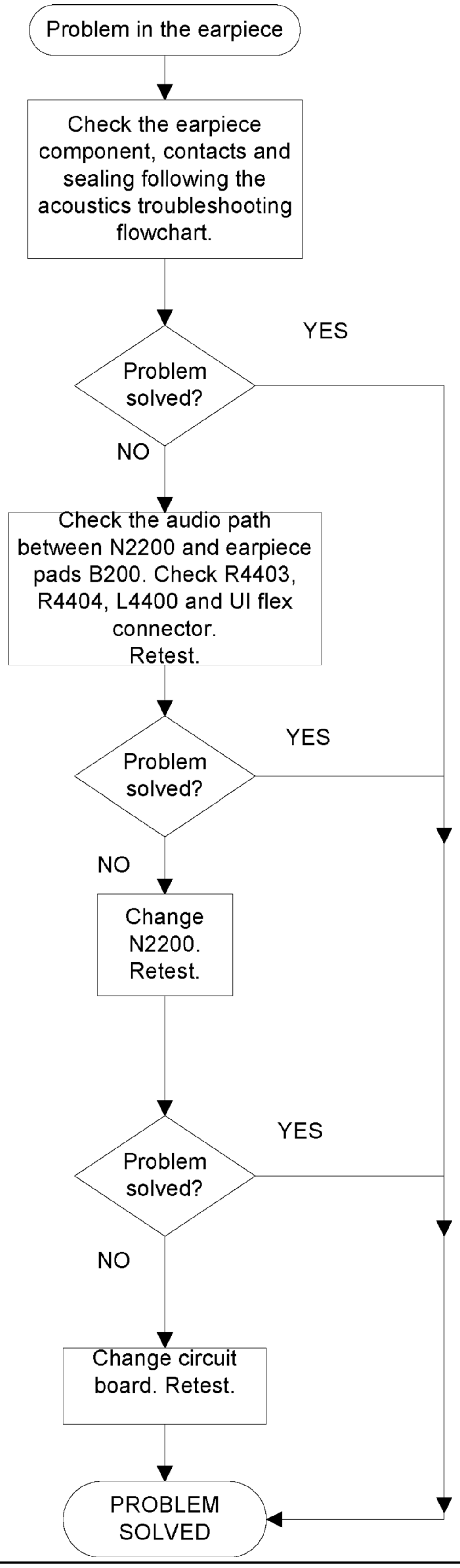
Table 10 Audio loop test reference results

Audio loop	Input terminal	Output terminal	Frequency	Input signal	Output signal
XMIC to EAR	AV connector	Internal earpiece	1kHz	0.1 [V]	y [V]
XMIC to IHF	AV connector	Stereo speakers	2kHz	0.1 [V]	y [A]
XMIC to XEAR	AV connector	AV connector	1kHz	0.1 [V]	y [V]
INTMIC to XEAR	Internal microphone	AV connector	1kHz	0.01 [V]	y [V]

Audio loop test reference results contains input signal and expected output signal values for each audio loop routine.

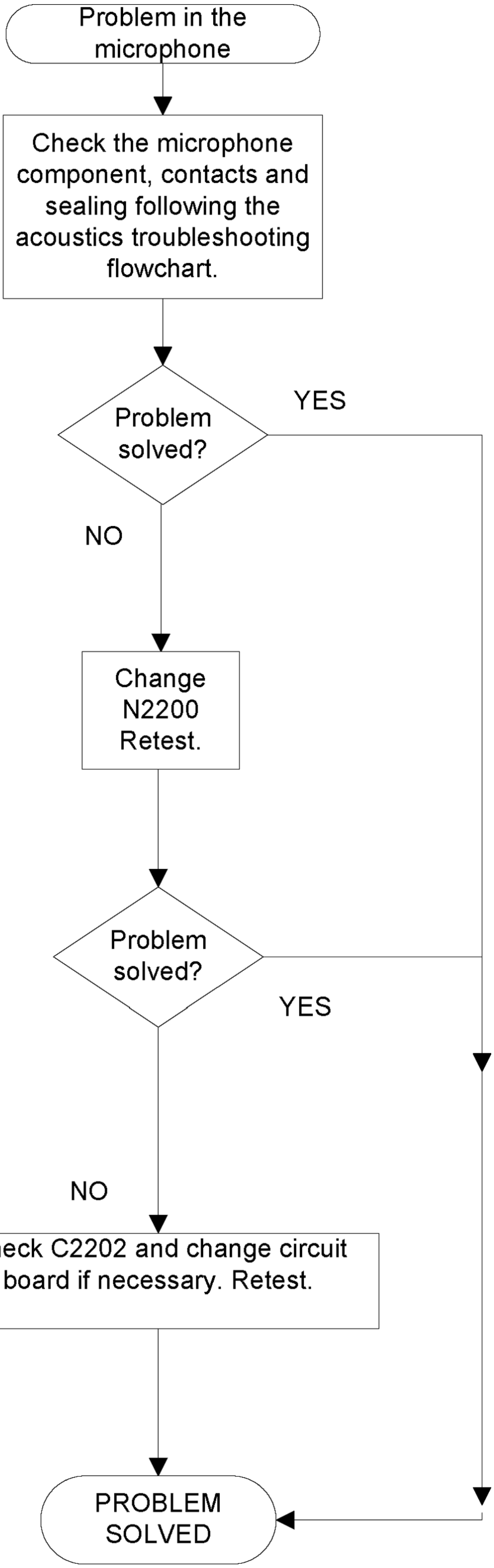
Internal earpiece troubleshooting

Troubleshooting flow


Problem in the earpiece
Check the earpiece component, contacts and sealing following the acoustics troubleshooting flowchart.
Problem solved?
YES
NO
Check the audio path between N2200 and earpiece pads B200. Check R4403, R4404, L4400 and UI flex connector. Retest.
Problem solved?
YES
NO
Change N2200. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

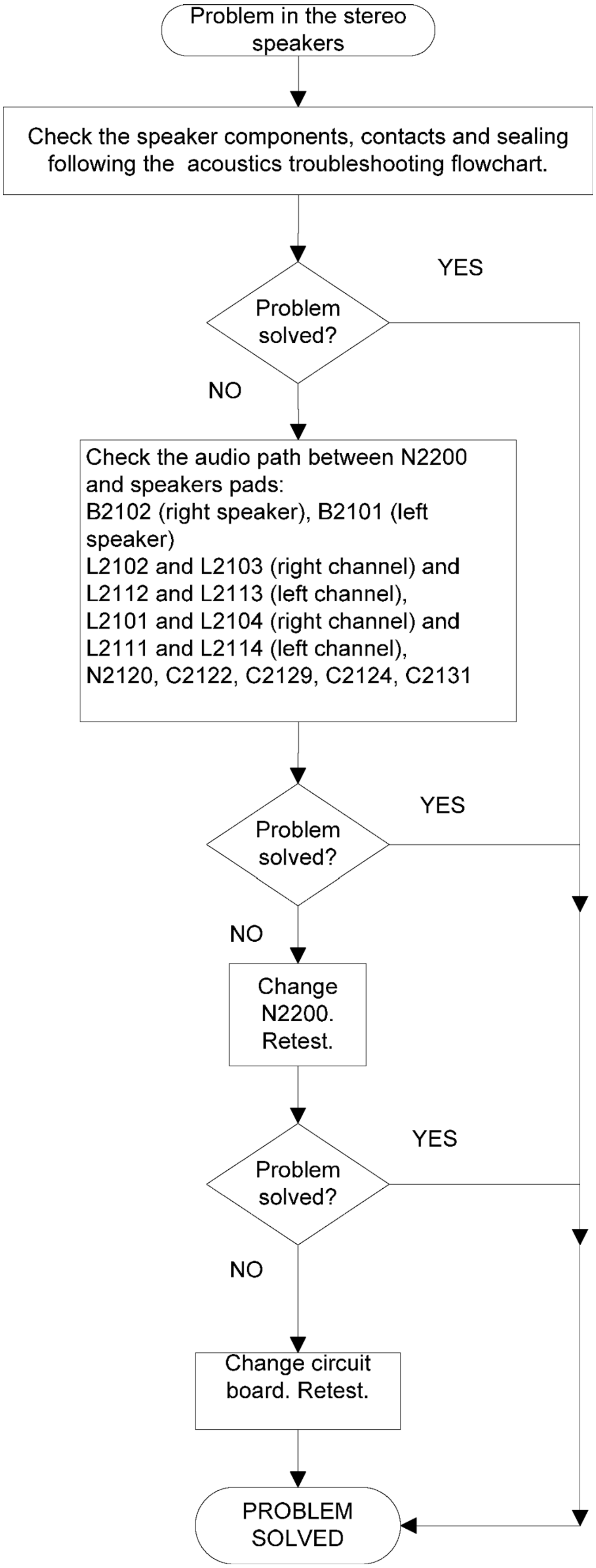
Internal microphone troubleshooting

Troubleshooting flow


Problem in the microphone
Check the microphone component, contacts and sealing following the acoustics troubleshooting flowchart.
Problem solved?
YES
NO
Change N2200 Retest.
Problem solved?
YES
NO
Check C2202 and change circuit board if necessary. Retest.
PROBLEM SOLVED

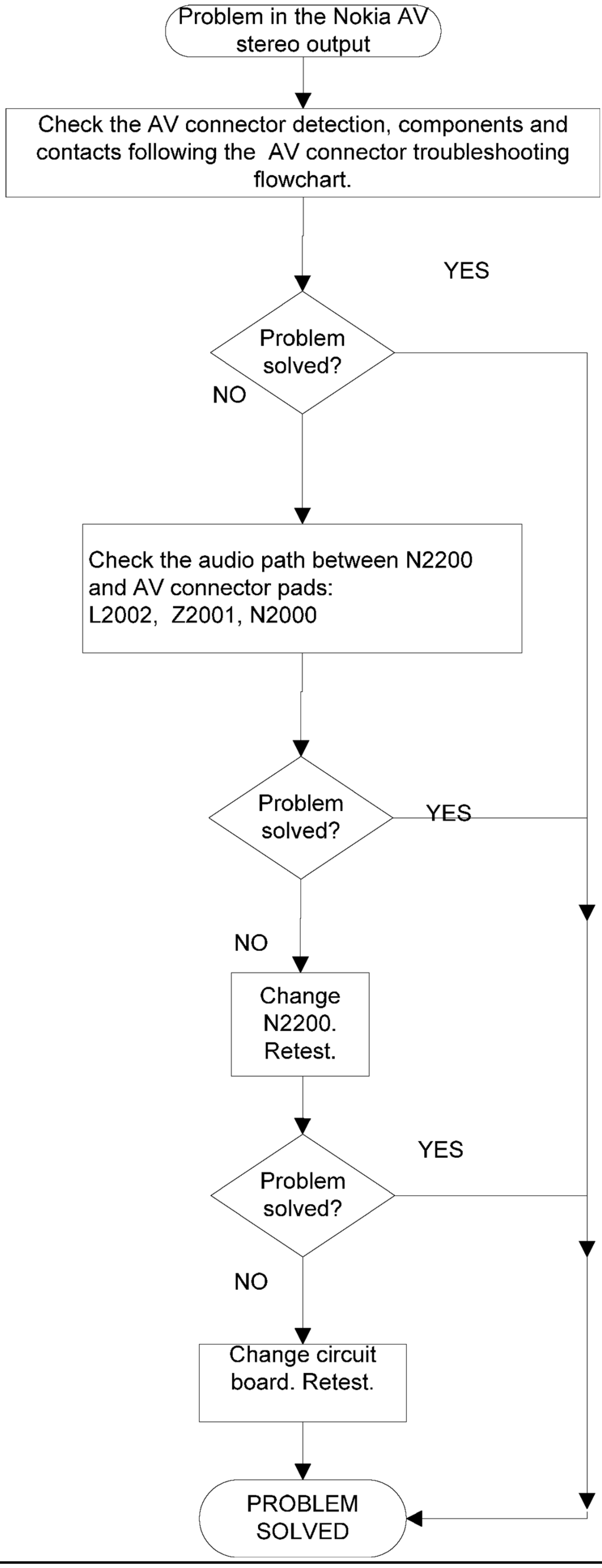
Stereo speakers troubleshooting

Troubleshooting flow


Problem in the stereo speakers
Check the speaker components, contacts and sealing following the acoustics troubleshooting flowchart.
Problem solved?
YES
NO
Check the audio path between N2200 and speakers pads:
B2102 (right speaker), B2101 (left speaker)
L2102 and L2103 (right channel) and L2112 and L2113 (left channel),
L2101 and L2104 (right channel) and L2111 and L2114 (left channel),
N2120, C2122, C2129, C2124, C2131
Problem solved?
YES
NO
Change N2200. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

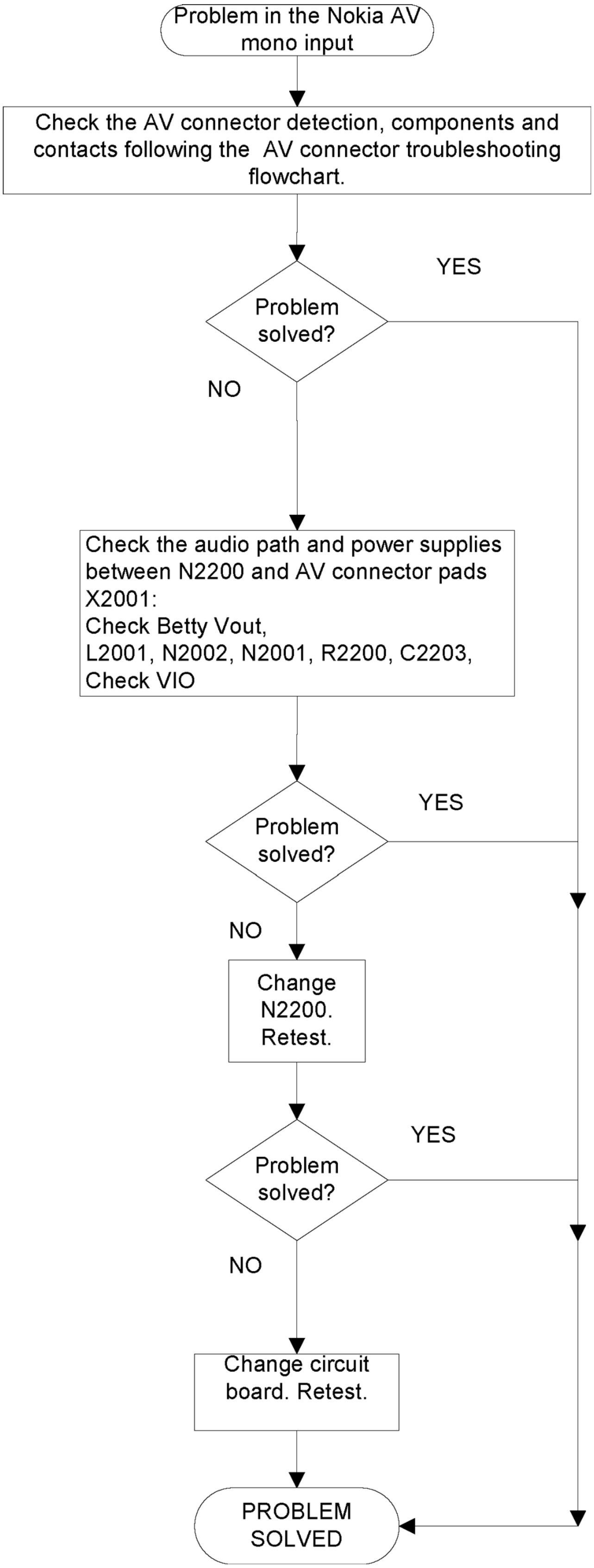
AV stereo output troubleshooting

Troubleshooting flow


Problem in the Nokia AV stereo output
Check the AV connector detection, components and contacts following the AV connector troubleshooting flowchart.
YES
Problem solved?
NO
Check the audio path between N2200 and AV connector pads:
L2002, Z2001, N2000
Problem solved?
YES
NO
Change N2200. Retest.
YES
Problem solved?
NO
Change circuit board. Retest.
PROBLEM SOLVED

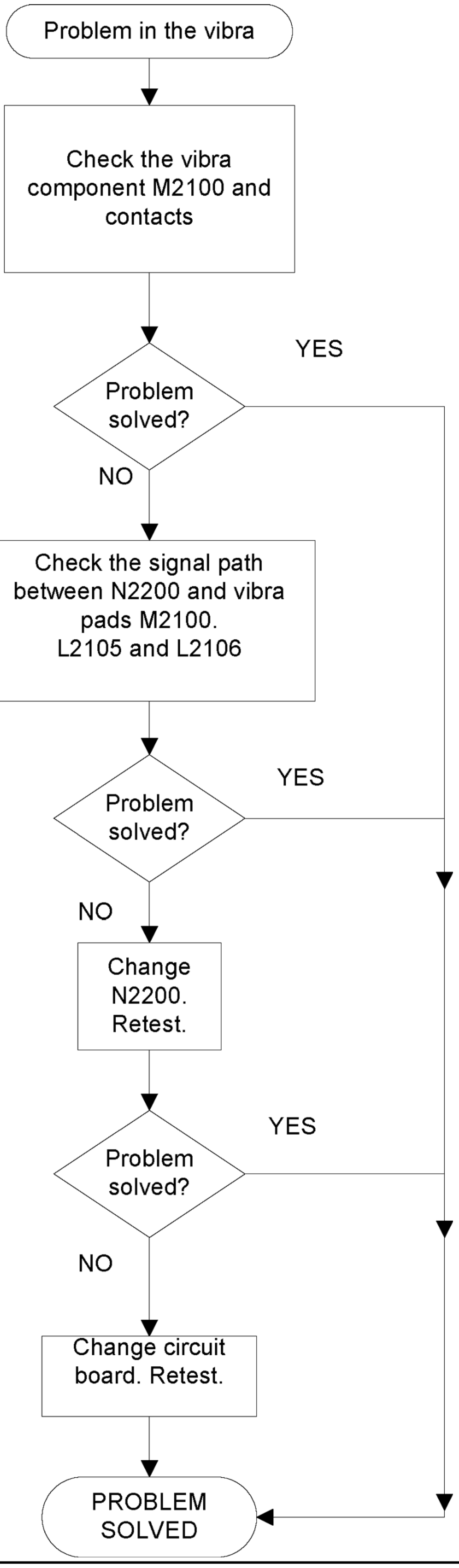
AV mono input troubleshooting

Troubleshooting flow


Problem in the Nokia AV mono input
Check the AV connector detection, components and contacts following the AV connector troubleshooting flowchart.
Problem solved?
YES
NO
Check the audio path and power supplies between N2200 and AV connector pads X2001:
Check Betty Vout,
L2001, N2002, N2001, R2200, C2203,
Check VIO
Problem solved?
YES
NO
Change N2200. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

Vibra troubleshooting

Troubleshooting flow


Problem in the vibra
Check the vibra component M2100 and contacts
Problem solved?
YES
NO
Check the signal path between N2200 and vibra pads M2100.
L2105 and L2106
Problem solved?
YES
NO
Change N2200. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

Baseband manual tuning guide

Energy management calibration

Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage**, **BSI**, **battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.

Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File→ Scan Product.**
4. Choose **Tuning→Energy Management Calibration.**
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.
6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

    Note: ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.

8. Click **Calibrate**.

    The calibration of the selected item(s) is carried out automatically.

    The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

Table 11 Calibration value limits

Parameter	Min.	Max.
ADC Gain	13000	13350
ADC Offset	-14	14
BSI Gain	1100	1300
VBAT_SCAL Gain	21000	21900
VBAT_SCAL Offset	2450	2570
IBAT Gain	7750	12250

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.

4 — RF troubleshooting

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General RF troubleshooting

Introduction to RF troubleshooting

Most RF semiconductors are static discharge sensitive

ESD protection must be applied during repair (ground straps and ESD soldering irons).

Pre-baking

These parts are moisture sensitive and must be pre-baked prior to soldering:

- RF IC N7505
- Front End Module (FEM) N7520
- WCDMA PA N7540

Discrete components

In addition to the key-components, there are a number of discrete components (resistors, inductors and capacitors) for which troubleshooting is done mainly by *visual inspection*.

Capacitors: check for short circuits.

Resistors: check value with an ohm meter.

> **Note:** In-circuit measurements should be evaluated carefully

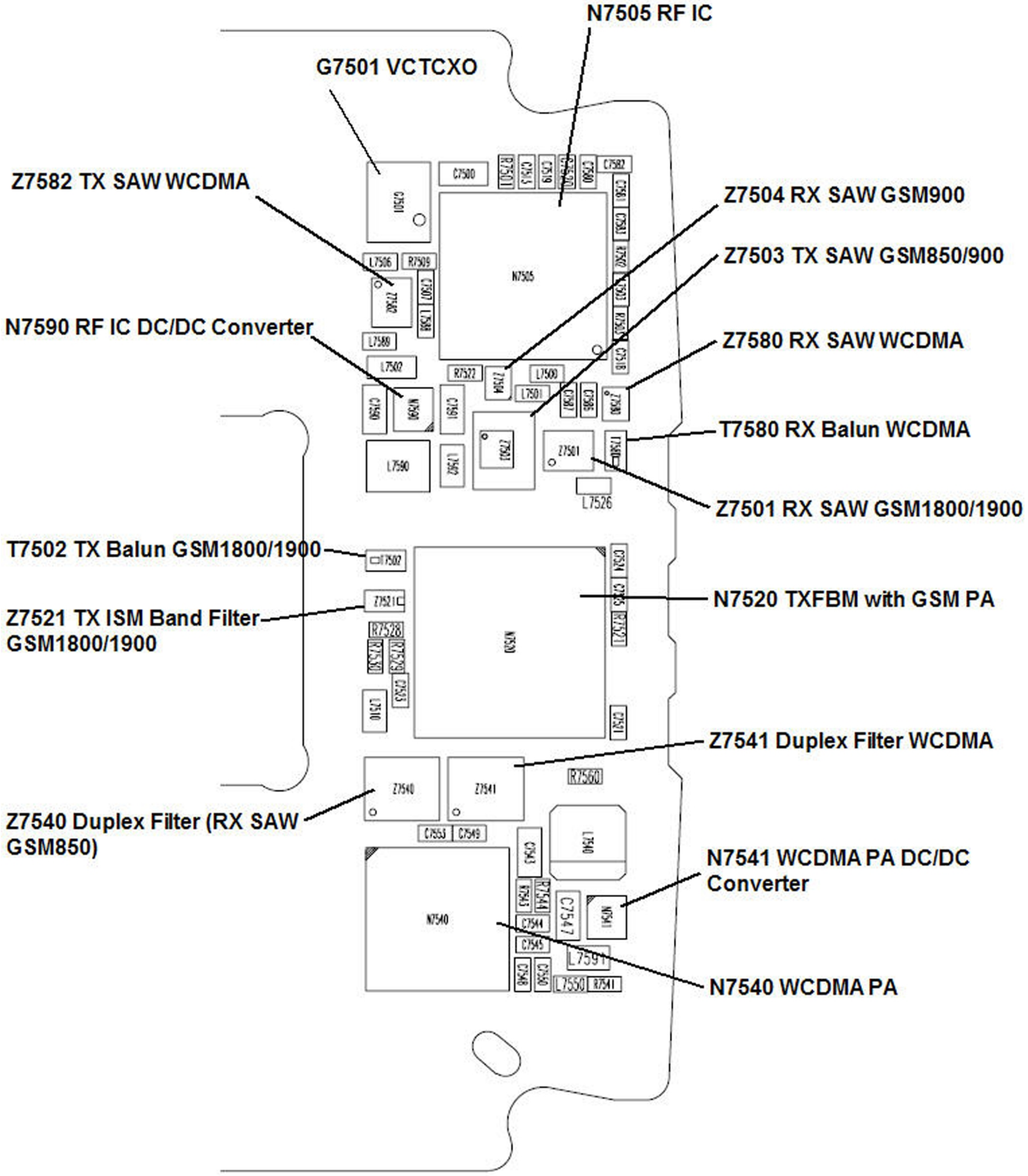
Measuring equipment

All measurements should be done using:

- An oscilloscope for low frequency and DC measurements. Recommended probe: 10:1, 10Mohm//8pF.
- A radio communication tester including RF generator and spectrum analyser, for example Rohde & Schwarz CMU200. (Alternatively a spectrum analyser and an RF generator can be used. Some tests in this guide are not possible to perform if this solution is chosen).

> **Note:** A mobile phone WCDMA transmitter should never be tested with full TX power (only it possible to perform the measurements in a good RF-shielded room). Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
>
> **Note:** All measurements with an RF coupler should be performed in an RF-shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, testing at frequencies of nearby base stations should be avoided.

RF key components


N7505 RF IC
G7501 VCTCXO
Z7582 TX SAW WCDMA
Z7504 RX SAW GSM900
Z7503 TX SAW GSM850/900
N7590 RF IC DC/DC Converter
Z7580 RX SAW WCDMA
T7580 RX Balun WCDMA
Z7501 RX SAW GSM1800/1900
T7502 TX Balun GSM1800/1900
N7520 TXFBM with GSM PA
Z7521 TX ISM Band Filter GSM1800/1900
Z7541 Duplex Filter WCDMA
Z7540 Duplex Filter (RX SAW GSM850)
N7541 WCDMA PA DC/DC Converter
N7540 WCDMA PA

Auto tuning for BB5.0

This phone can be tuned automatically.

Autotune is designed to align the phone's RF part easier and faster. It performs calibrations, tunings and measurements of RX and TX. The results are displayed and logged in a result file, if initiated.

Hardware set up

Hardware requirements for auto tuning:

- PC (Windows 2000/XP) with GPIB card

- Power supply
- Product specific module jig
- Cables: XRF-1 (RF cable), USB cable, GBIP cable and DAU-9S
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

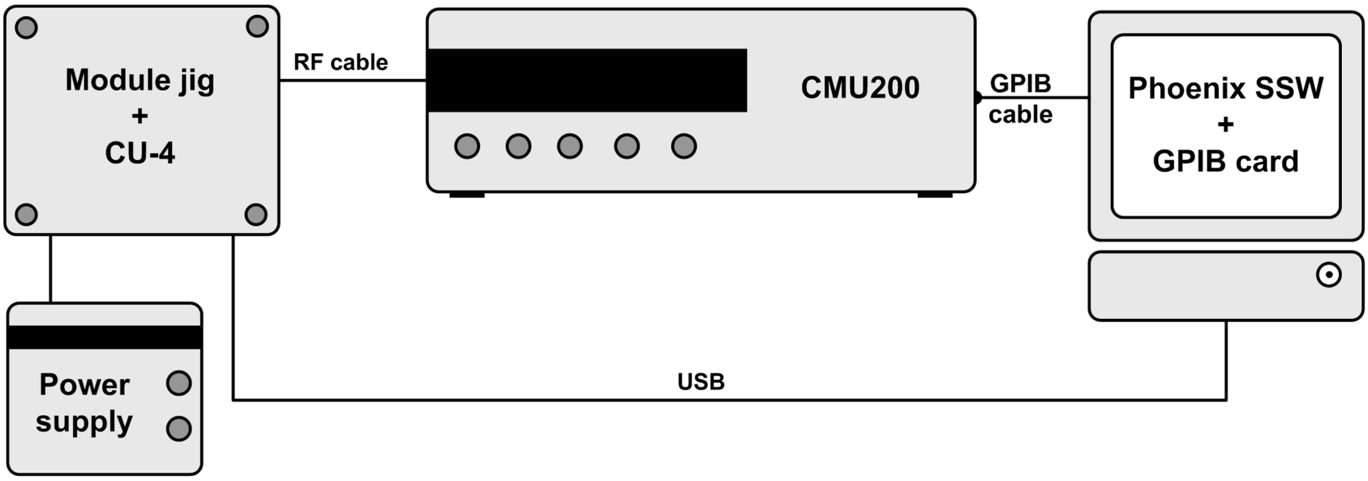


Figure 28 Auto tuning concept with CMU200

Note: Crossover Cable connection between computer and CU200 is recommended (refer to Service Devices chapter and Module Jig concept).

Phoenix preparations

Install the phone specific data package. This defines phone specific settings.

Auto tuning procedure

1. Make sure the phone (in the jig) is connected to the equipment. Else, some menus will not be shown in Phoenix.
2. To go to autotune, select *Tuning (Alt-U)* > *Auto-Tune (Alt-A)* from the menu.
3. Start autotuning, clicking the *Tune* button.

WLAN autotuning

This phone can be tuned automatically.

WLAN autotune is designed to align the phone's WLAN part easier and faster. It performs calibrations and tunings of TX. The results are displayed and logged in a result file, if initiated.

Hardware set up

Hardware requirements for auto tuning:

- PC (Windows 2000/XP) with GPIB card
- Power supply
- Product specific module jig
- Cables: XRF-1 (RF cable), USB cable, GBIP cable and DAU-9S
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

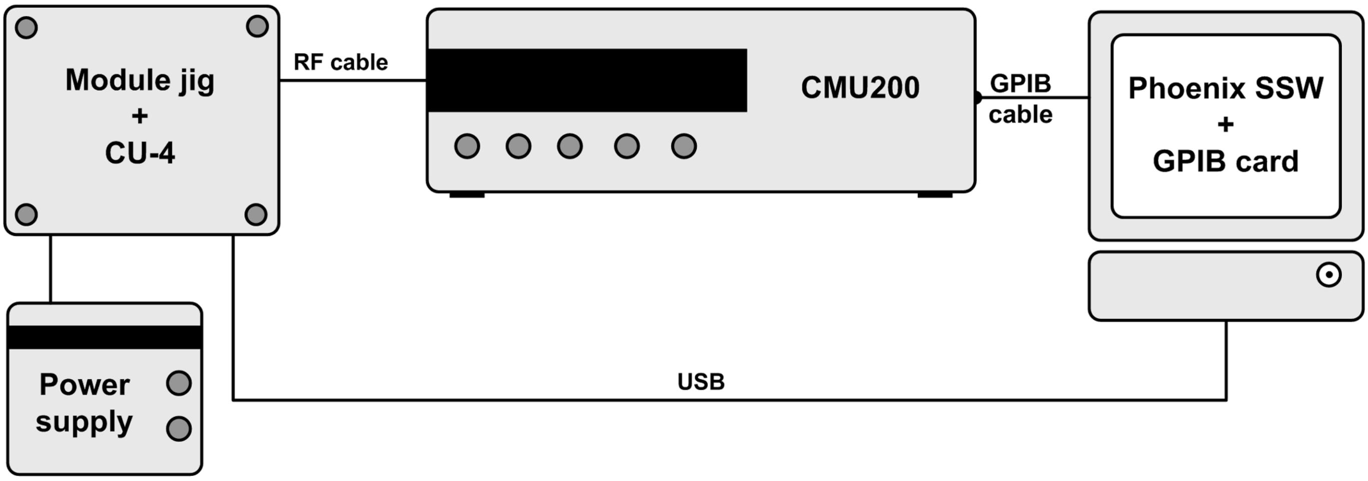


Figure 29 WLAN autotuning concept with CMU200

Phoenix preparations

Install the phone specific data package. This defines phone specific settings.

Auto tuning procedure

1 Make sure the phone (in the jig) is connected to the equipment. Else, some menus will not be shown in Phoenix.

2 To go to autotune, select *Tuning* > *WLAN Auto-Tune* from the menu.

3 Start WLAN autotuning by clicking the *Tune* button.

General chekings

Antenna line component checking

Check L7560 (0ohm resistor).

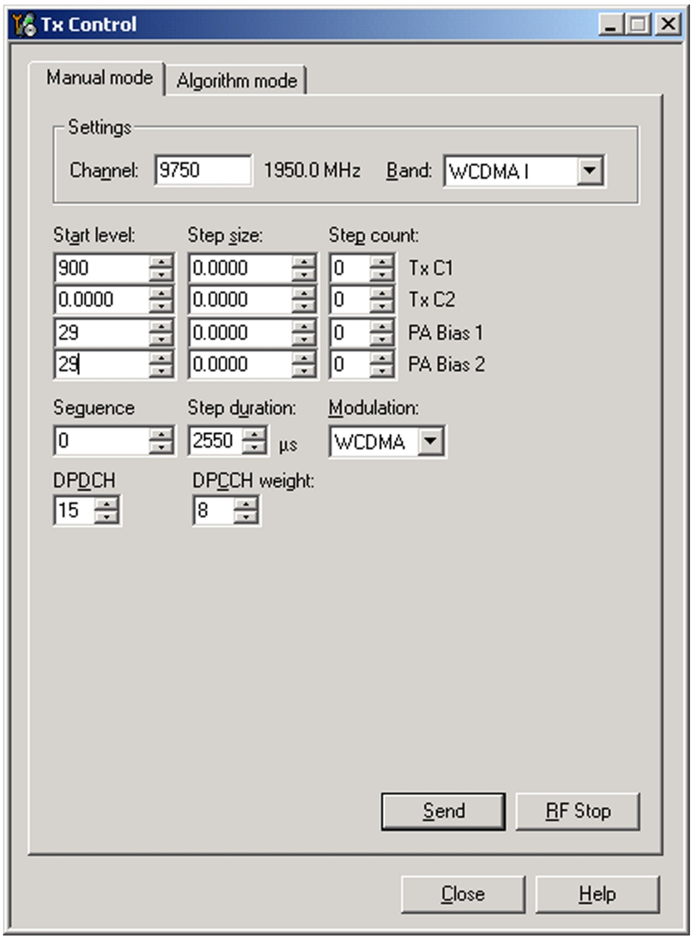
Voltage checking

Steps

1. Set up the main board in the module jig. The phone should be in local mode.
2. Check the following:

#	Signal name	Test point	Voltage (all bands)
1	VCTCXO supply	R7501	2.5 V
2	AHNEUS supply from DC/DC conv	L7502	3.2 V
3	TXFBM supply	C7523	3.9 V
4	WCDMA PA supply from DC/DC conv	C7543	0 V (When transmitting 1.3 V - 3.1 V depending on output power. *3.1 V with settings as in the note below.)
5	Vbat at WCDMA PA	L7550	3.9 V
6	Supply to AHNEUS DC/DC conv	L7592	3.9 V

* With these settings, the result should be 3.1V.


Tx Control
Manual mode
Algorithm mode
Send
RF Stop
Close
Help

Settings

Channel: 9750 1950.0 MHz Band: WCDMA I

Start level:	Step size:	Step count:	
900	0.0000	0	Tx C1
0.0000	0.0000	0	Tx C2
29	0.0000	0	PA Bias 1
29	0.0000	0	PA Bias 2

Sequence: 0

Step duration: 2550 µs

Modulation: WCDMA

DPDCH: 15

DPCCH weight: 8

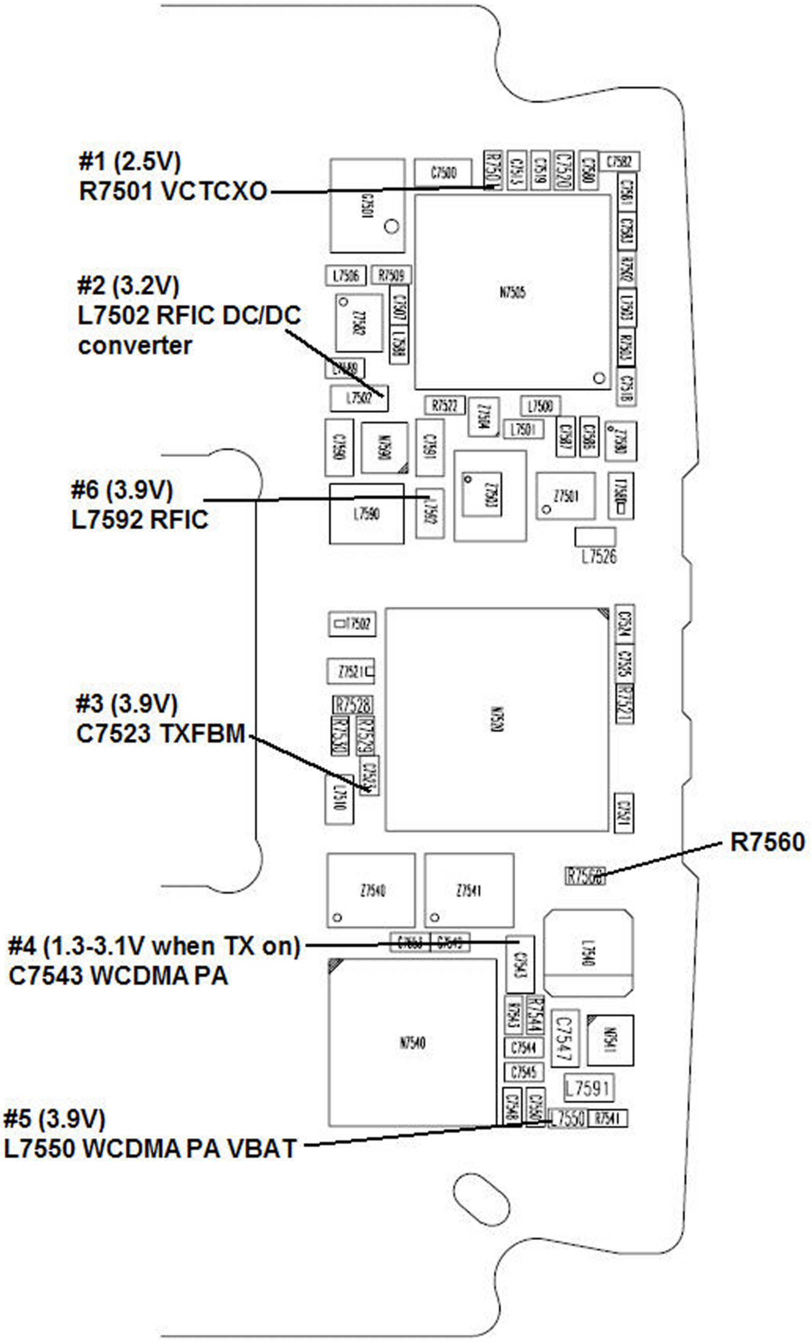
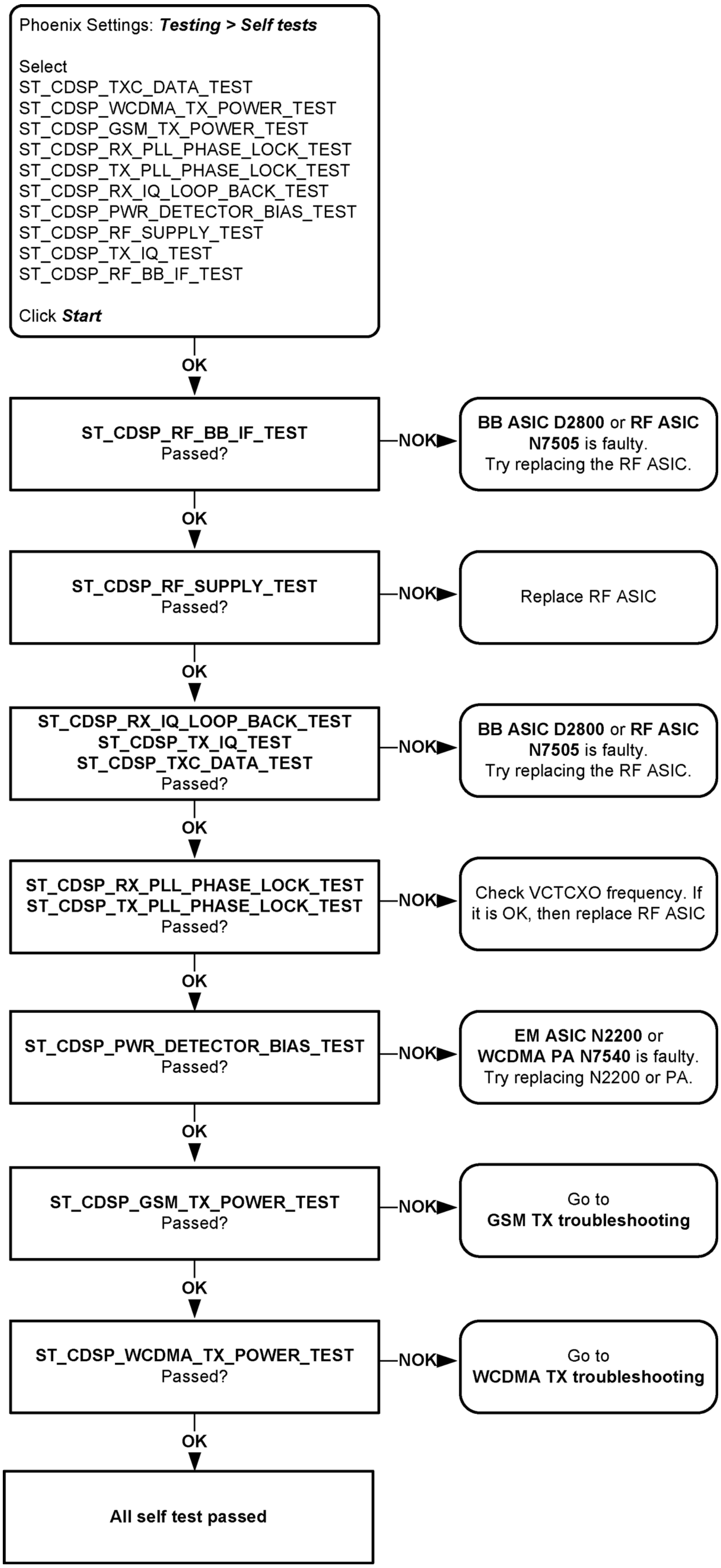

#1 (2.5V)
R7501 VCTCXO
#2 (3.2V)
L7502 RFIC DC/DC
converter
#6 (3.9V)
L7592 RFIC
#3 (3.9V)
C7523 TXFBM
R7560
#4 (1.3-3.1V when TX on)
C7543 WCDMA PA
#5 (3.9V)
L7550 WCDMA PA VBAT
N7505
N7520
N7540
Z7540
Z7541
L7540
L7590
L7526
L7591
L7550
C7547
N7541

Figure 30 General voltage checking test points

Self test troubleshooting

Troubleshooting flow



Phoenix Settings: ***Testing > Self tests***

Select
ST_CDSP_TXC_DATA_TEST
ST_CDSP_WCDMA_TX_POWER_TEST
ST_CDSP_GSM_TX_POWER_TEST
ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_PWR_DETECTOR_BIAS_TEST
ST_CDSP_RF_SUPPLY_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_RF_BB_IF_TEST

Click ***Start***

ST_CDSP_RF_BB_IF_TEST Passed?

BB ASIC D2800 or **RF ASIC N7505** is faulty. Try replacing the RF ASIC.

ST_CDSP_RF_SUPPLY_TEST Passed?

Replace RF ASIC

ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_TXC_DATA_TEST
Passed?

BB ASIC D2800 or **RF ASIC N7505** is faulty. Try replacing the RF ASIC.

ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
Passed?

Check VCTCXO frequency. If it is OK, then replace RF ASIC

ST_CDSP_PWR_DETECTOR_BIAS_TEST Passed?

EM ASIC N2200 or **WCDMA PA N7540** is faulty. Try replacing N2200 or PA.

ST_CDSP_GSM_TX_POWER_TEST Passed?

Go to **GSM TX troubleshooting**

ST_CDSP_WCDMA_TX_POWER_TEST Passed?

Go to **WCDMA TX troubleshooting**

All self test passed

Receiver troubleshooting

Introduction to receiver (RX) troubleshooting

RX can be tested by making a phone call or in local mode. For the local mode testing, use Phoenix service software.

The main RX troubleshooting measurement is RSSI reading. This test measures the signal strength of the received signal. For GSM RSSI measurements, see GSM RX chain activation for manual measurements / GSM RSSI measurement (page 4–12). For a similar test in WCDMA mode, see WCDMA RSSI measurement (page).

GSM RX chain activation for manual measurements/GSM RSSI measurement

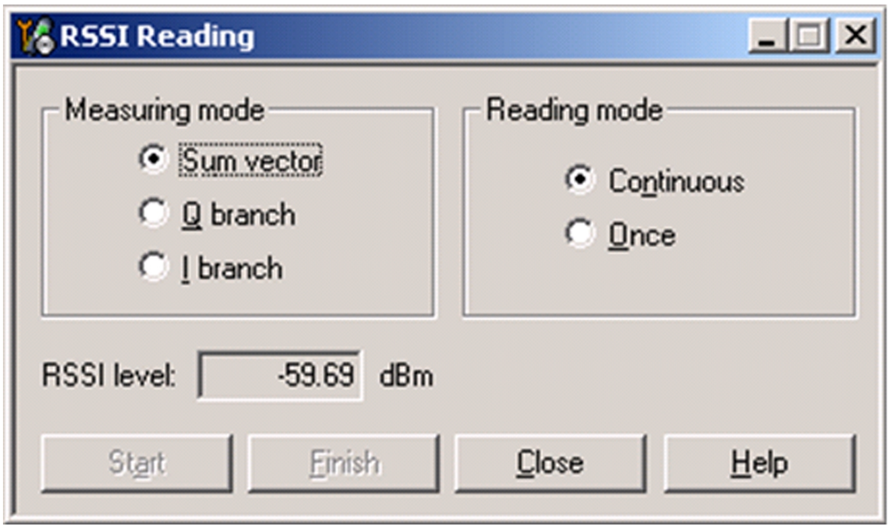
Prerequisites

Make the following settings in Phoenix service software:

Setting	GSM850	GSM900	GSM1800	GSM1900
Phoenix Channel	189	37	700	661
Signal generator to antenna connector	881.46771MHz (67.71KHz offset) at -60dBm	942.46771MHz (67.71kHz offset) at -60dBm	1842.86771MHz (67.71kHz offset) at -60dBm	1960.06771MHz (67.71kHz offset) at -60dBm

Steps

1. Set the phone to local mode.
2. Activate RSSI reading in Phoenix (**Testing→GSM→RSSI reading**)


RSSI Reading

Measuring mode
● Sum vector
○ Q branch
○ I branch

Reading mode
● Continuous
○ Once

RSSI level: -59.69 dBm

Results

The reading should reflect the level of the signal generator (-losses) +/- 5 dB.

When varying the level in the range -30 to -102 dBm the reading should then follow within +/-5 dB.

WCDMA RX chain activation for manual measurement/WCDMA RSSI measurement

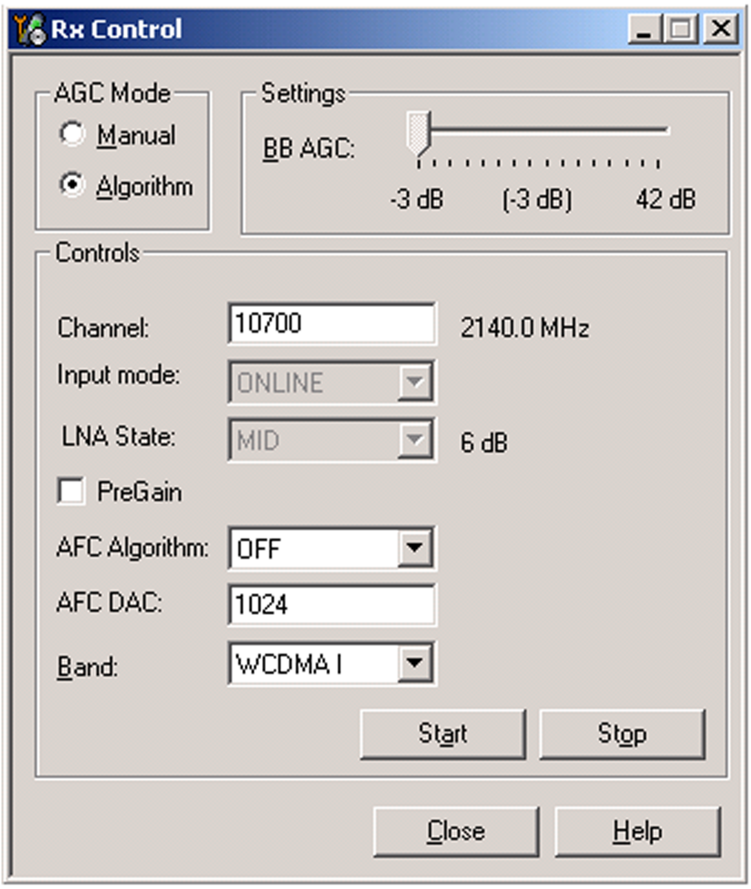
Prerequisites

Make the following settings in Phoenix service software and in the signal generator.

Setting	Band I
Phoenix channel	10700
Signal generator to antenna connector	2141.0 MHz
Signal generator RF-level (CW-signal)	-70 dBm

Steps

1. Via Phoenix Testing menu, choose **WCDMA/RX Control**.
2. In the RX control window, make the following settings:



Rx Control

AGC Mode
○ Manual
● Algorithm

Settings
BB AGC: -3 dB (-3 dB) 42 dB

Controls
Channel: 10700 2140.0 MHz
Input mode: ONLINE
LNA State: MID 6 dB
☐ PreGain
AFC Algorithm: OFF
AFC DAC: 1024
Band: WCDMA I

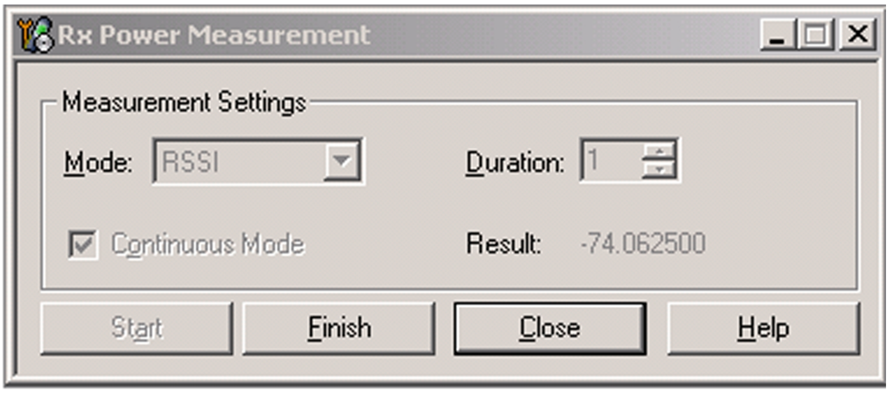
Figure 31 RX Control window with example settings

3. Click **Start** to activate the settings.

   If the settings are changed later on (for example, change of channel) you have to click **Stop** and **Start** again.

   Note: Clicking **Stop** also disables TX control if it was active.
4. From the Phoenix testing menu, select **WCDMA→RX Power measurement**
5. In the RX Power measurement window, select:

- Mode: RSSI
- Continuous mode



Mode: RSSI
Duration: 1
☑ Continuous Mode
Result: -74.062500

6. Click **Start** to perform the measurement.

Results

The reading should reflect the level of the signal generator (-losses) ± 5 dB.

Transmitter troubleshooting

General instructions for transmitter (TX) troubleshooting

Please note the following before performing transmitter tests:

- TX troubleshooting requires TX operation.
- Do not transmit on frequencies that are in use!
- The transmitter can be controlled in local mode for diagnostic purposes.
- The most useful Phoenix tool for GSM transmitter testing is “RF Controls”; in WCDMA transmitter testing the best tool is “TX Control”.
- Remember that re-tuning is not a fix! Phones are tuned correctly in production

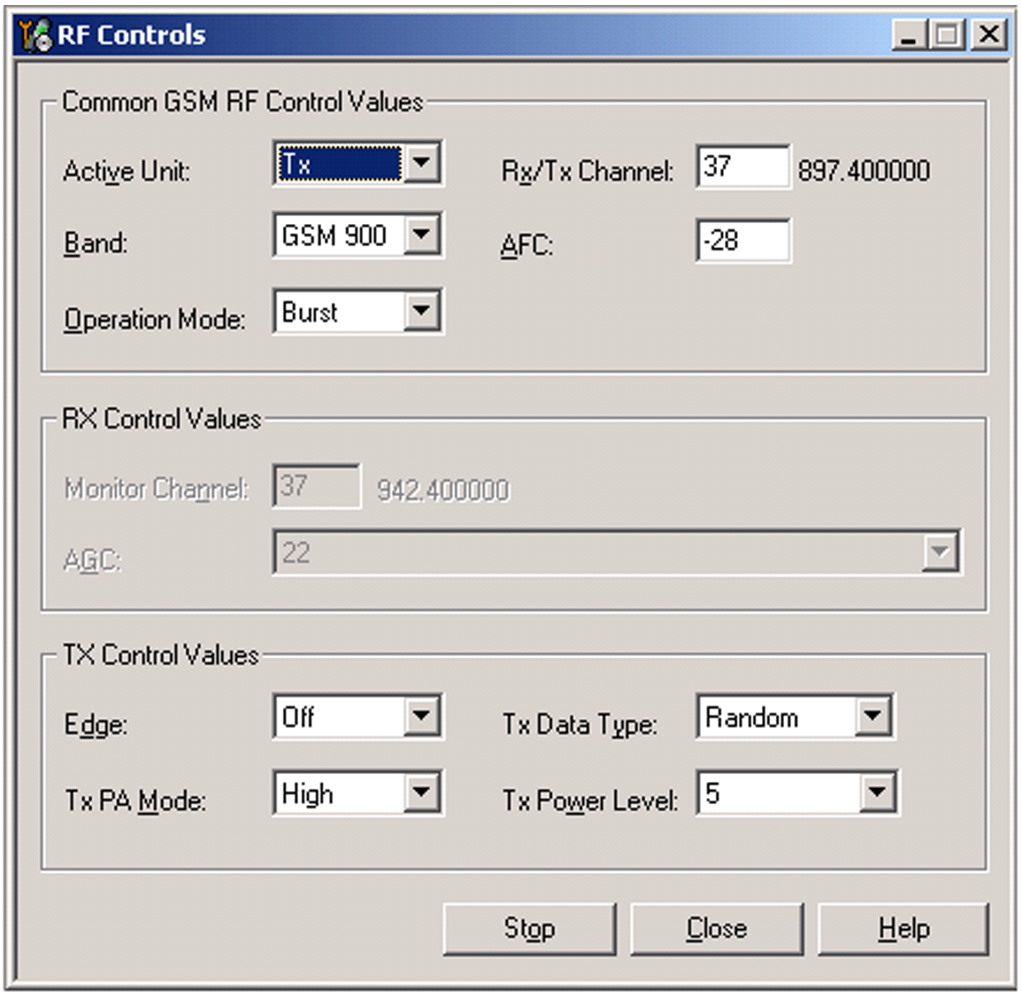
Note: Never activate the GSM or WCDMA transmitter without a proper antenna load. Always connect a 50 Ω load to the RF connector (antenna, RF-measurement equipment or at least a 2 W dummy load); otherwise the GSM or WCDMA Power amplifier (PA) may be damaged.

GSM transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. Activate RF controls in Phoenix (**Testing→GSM→Rf Controls**).

   Make settings as shown in the picture:



RF Controls

Common GSM RF Control Values

Active Unit: Tx

Band: GSM 900

Operation Mode: Burst

Rx/Tx Channel: 37 897.400000

AFC: -28

RX Control Values

Monitor Channel: 37 942.400000

AGC: 22

TX Control Values

Edge: Off

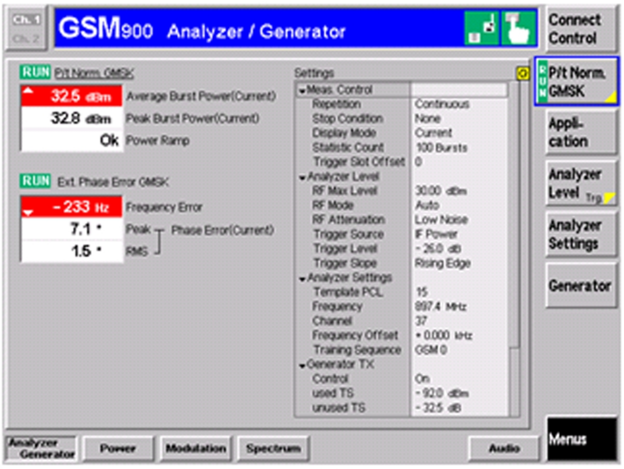
Tx PA Mode: High

Tx Data Type: Random

Tx Power Level: 5

3. Check the basic TX parameters (i.e. power, phase error, modulation and switching spectrum), using a communication analyser (for example CMU200).

Analyser settings


Ch. 1
Ch. 2
GSM900 Analyzer / Generator
Connect Control
RUN P/t Norm. GMSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Menus
Analyzer Generator
Power
Modulation
Spectrum
Audio

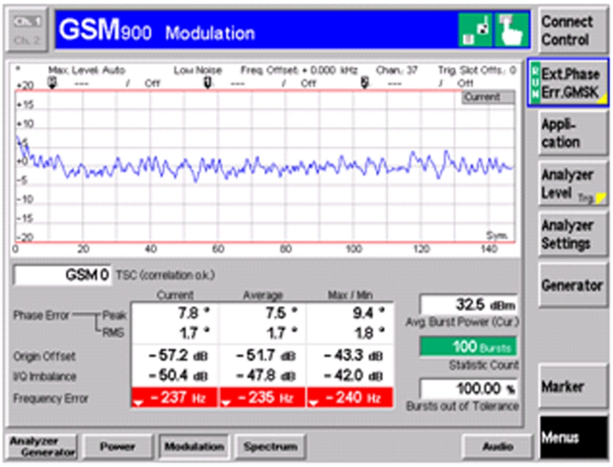
RUN P/t Norm. GMSK
32.5 dBm Average Burst Power(Current)
32.8 dBm Peak Burst Power(Current)
Ok Power Ramp

RUN Ext. Phase Error GMSK
- 233 Hz Frequency Error
7.1 ° Peak – Phase Error(Current)
1.5 ° RMS

Settings

Meas. Control	
Repetition	Continuous
Stop Condition	None
Display Mode	Current
Statistic Count	100 Bursts
Trigger Slot Offset	0
Analyzer Level	
RF Max Level	30.00 dBm
RF Mode	Auto
RF Attenuation	Low Noise
Trigger Source	IF Power
Trigger Level	- 26.0 dB
Trigger Slope	Rising Edge
Analyzer Settings	
Template PCL	15
Frequency	897.4 MHz
Channel	37
Frequency Offset	+ 0.000 kHz
Training Sequence	GSM 0
Generator TX	
Control	On
used TS	- 92.0 dBm
unused TS	- 32.5 dB

Phase error

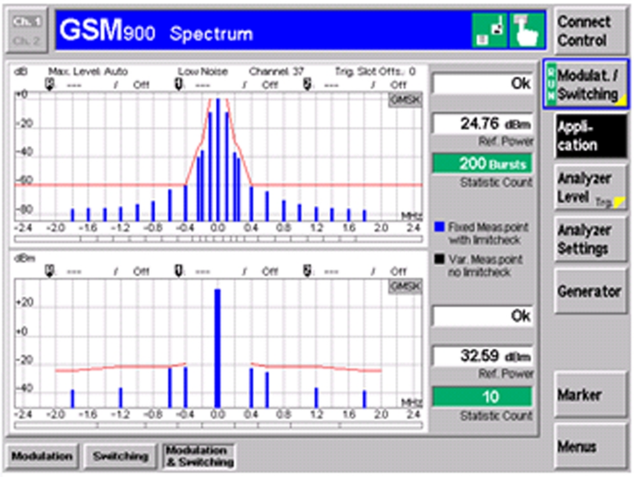

Ch. 1
Ch. 2
GSM900 Modulation
Connect Control
RUN Ext.Phase Err.GMSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Marker
Menus
Max. Level: Auto
Low Noise
Freq. Offset: + 0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Off
Current
+20
+15
+10
+5
+0
-5
-10
-15
-20
Sym.
0
20
40
60
80
100
120
140
Analyzer Generator
Power
Modulation
Spectrum
Audio

GSM 0 TSC (correlation o.k.)

		Current	Average	Max / Min
Phase Error	Peak	7.8 °	7.5 °	9.4 °
	RMS	1.7 °	1.7 °	1.8 °
Origin Offset		- 57.2 dB	- 51.7 dB	- 43.3 dB
I/Q Imbalance		- 50.4 dB	- 47.8 dB	- 42.0 dB
Frequency Error		- 237 Hz	- 235 Hz	- 240 Hz

32.5 dBm Avg. Burst Power (Cur.)
100 Bursts Statistic Count
100.00 % Bursts out of Tolerance

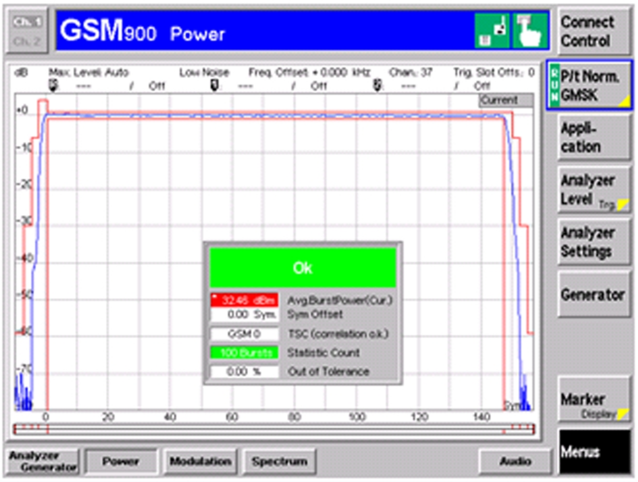
Modulation/Switching spectrum


Ch. 1
Ch. 2
GSM900 Spectrum
Connect Control
RUN Modulat. / Switching
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Marker
Menus
dB
Max. Level: Auto
Low Noise
Channel: 37
Trig. Slot Offs.: 0
Off
GMSK
+0
-20
-40
-60
-80
MHz
-2.4
-2.0
-1.6
-1.2
-0.8
-0.4
0.0
0.4
0.8
1.2
1.6
2.0
2.4
dBm
+20
+0
-20
-40
Fixed Meas.point with limitcheck
Var. Meas.point no limitcheck
Modulation
Switching
Modulation & Switching

Ok
24.76 dBm Ref. Power
200 Bursts Statistic Count

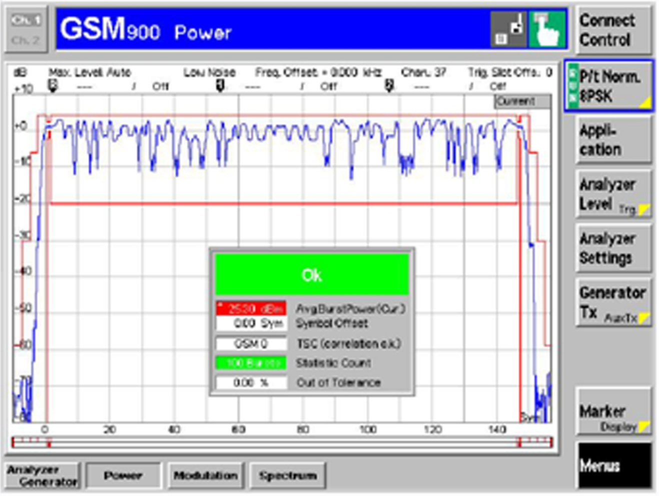
Ok
32.59 dBm Ref. Power
10 Statistic Count

Power/Burst


Ch. 1
Ch. 2
GSM900 Power
Connect Control
RUN P/t Norm. GMSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Marker Display
Menus
dB
Max. Level: Auto
Low Noise
Freq. Offset: + 0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Off
Current
+0
-10
-20
-30
-40
-50
-60
-70
Sym.
0
20
40
60
80
100
120
140
Analyzer Generator
Power
Modulation
Spectrum
Audio

Ok
32.46 dBm Avg.BurstPower(Cur.)
0.00 Sym. Sym.Offset
GSM 0 TSC (correlation o.k.)
100 Bursts Statistic Count
0.00 % Out of Tolerance

Edge


Ch. 1
Ch. 2
GSM900 Power
Connect Control
RUN P/t Norm. 8PSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator Tx AuxTx
Marker Display
Menus
dB
Max. Level: Auto
Low Noise
Freq. Offset: + 0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Off
Current
+10
+0
-10
-20
-30
-40
-50
-60
-70
Sym.
0
20
40
60
80
100
120
140
Analyzer Generator
Power
Modulation
Spectrum

Ok
25.30 dBm Avg.BurstPower(Cur.)
0.00 Sym. Symbol Offset
GSM 0 TSC (correlation o.k.)
100 Bursts Statistic Count
0.00 % Out of Tolerance

Figure 32 Typical readings

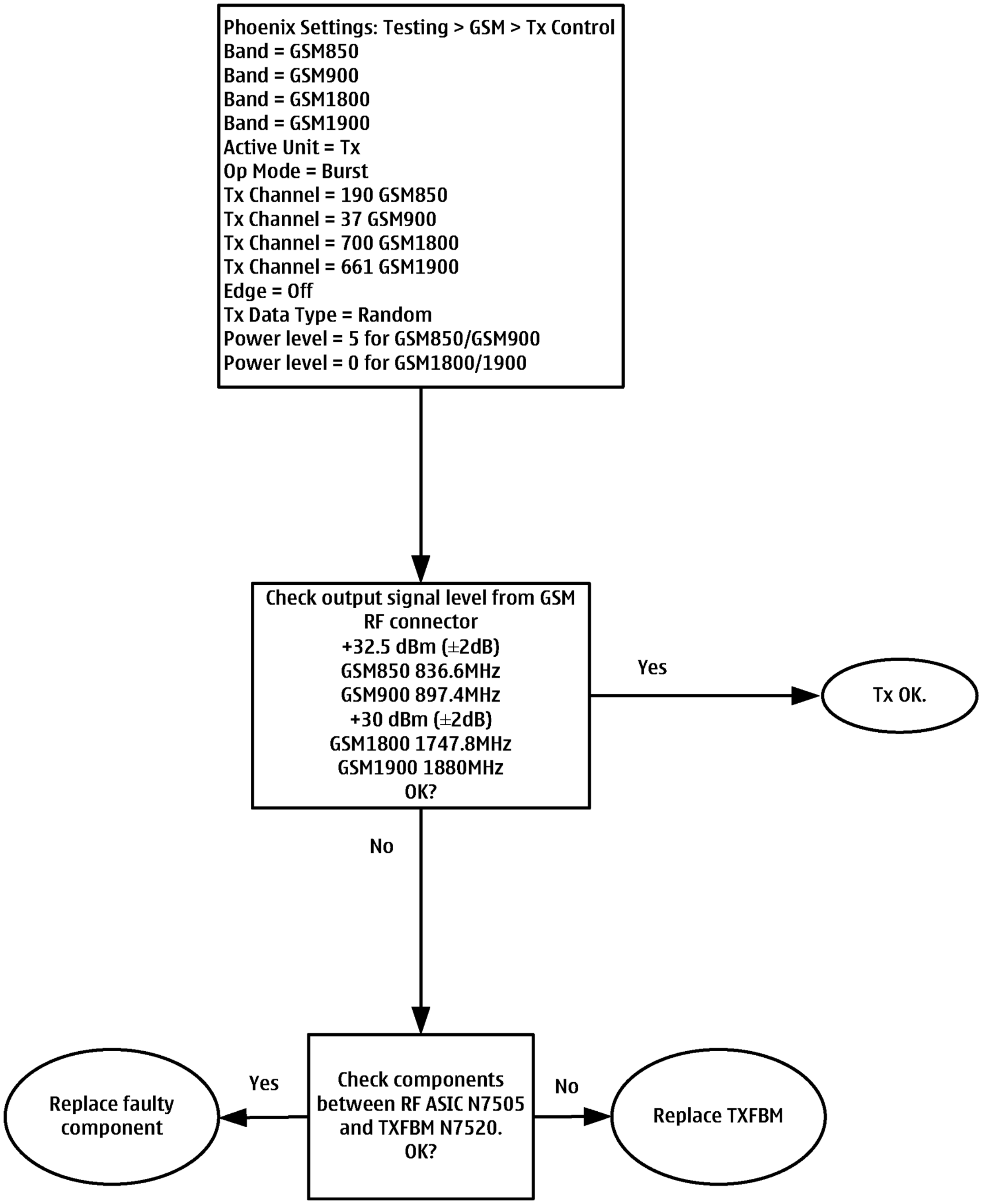
4. Change power level (RF controls) and make sure the power reading follows accordingly.

Next actions

If you want to troubleshoot the other bands, change band with RF controls and set the communication analyser accordingly.

GSM transmitter troubleshooting flowchart

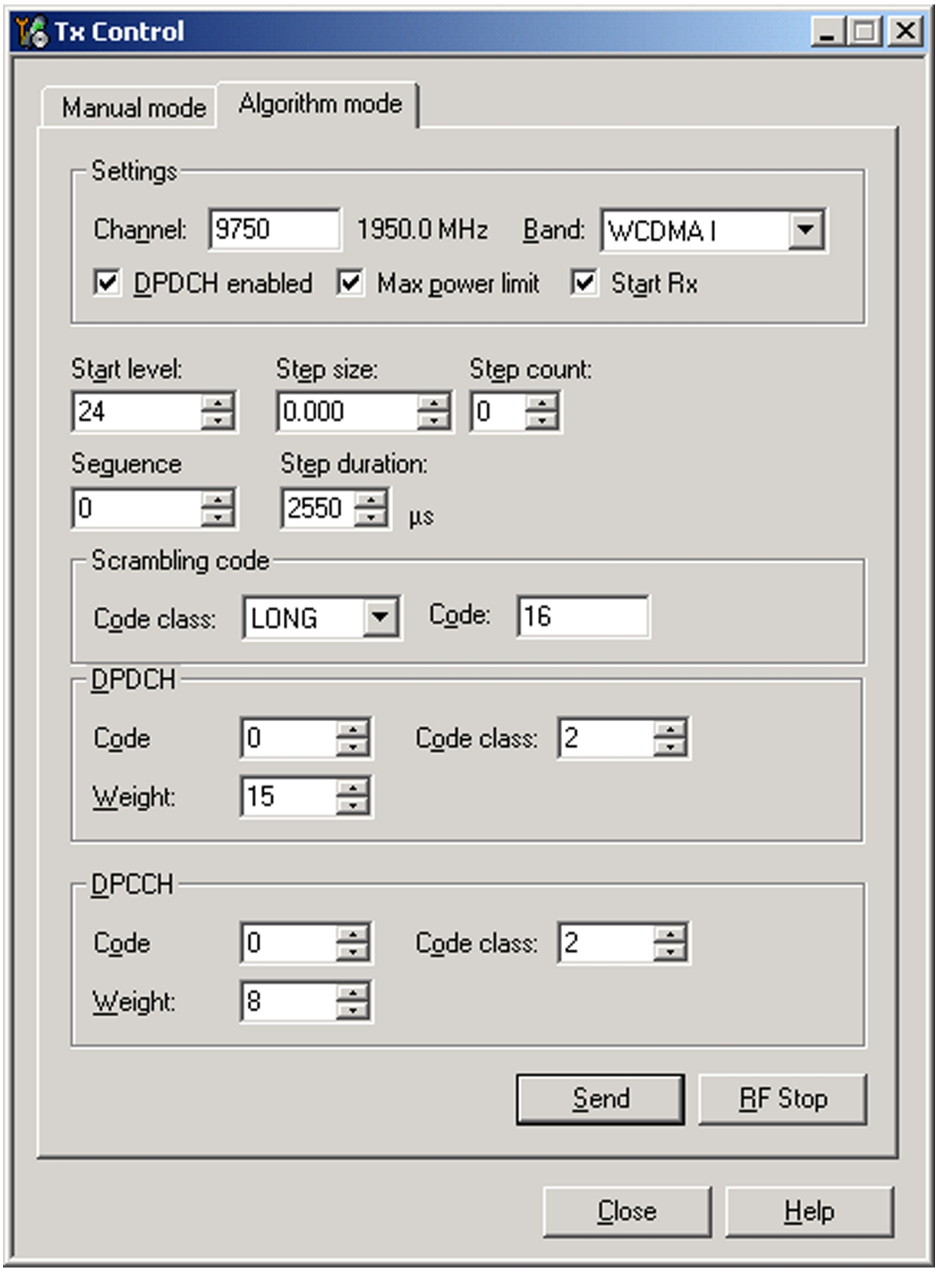
Troubleshooting flow


Phoenix Settings: Testing > GSM > Tx Control
Band = GSM850
Band = GSM900
Band = GSM1800
Band = GSM1900
Active Unit = Tx
Op Mode = Burst
Tx Channel = 190 GSM850
Tx Channel = 37 GSM900
Tx Channel = 700 GSM1800
Tx Channel = 661 GSM1900
Edge = Off
Tx Data Type = Random
Power level = 5 for GSM850/GSM900
Power level = 0 for GSM1800/1900
Check output signal level from GSM RF connector
+32.5 dBm (±2dB)
GSM850 836.6MHz
GSM900 897.4MHz
+30 dBm (±2dB)
GSM1800 1747.8MHz
GSM1900 1880MHz
OK?
Yes
Tx OK.
No
Check components between RF ASIC N7505 and TXFBM N7520.
OK?
Yes
Replace faulty component
No
Replace TXFBM

WCDMA transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. In Phoenix, select **Testing→WCDMA→TX control** .
3. In the TX control window, make settings like in the picture:



Settings
Channel: 9750 1950.0 MHz Band: WCDMA I
☑ DPDCH enabled ☑ Max power limit ☑ Start Rx
Start level: 24
Step size: 0.000
Step count: 0
Sequence 0
Step duration: 2550 µs

Scrambling code
Code class: LONG
Code: 16

DPDCH
Code 0
Code class: 2
Weight: 15

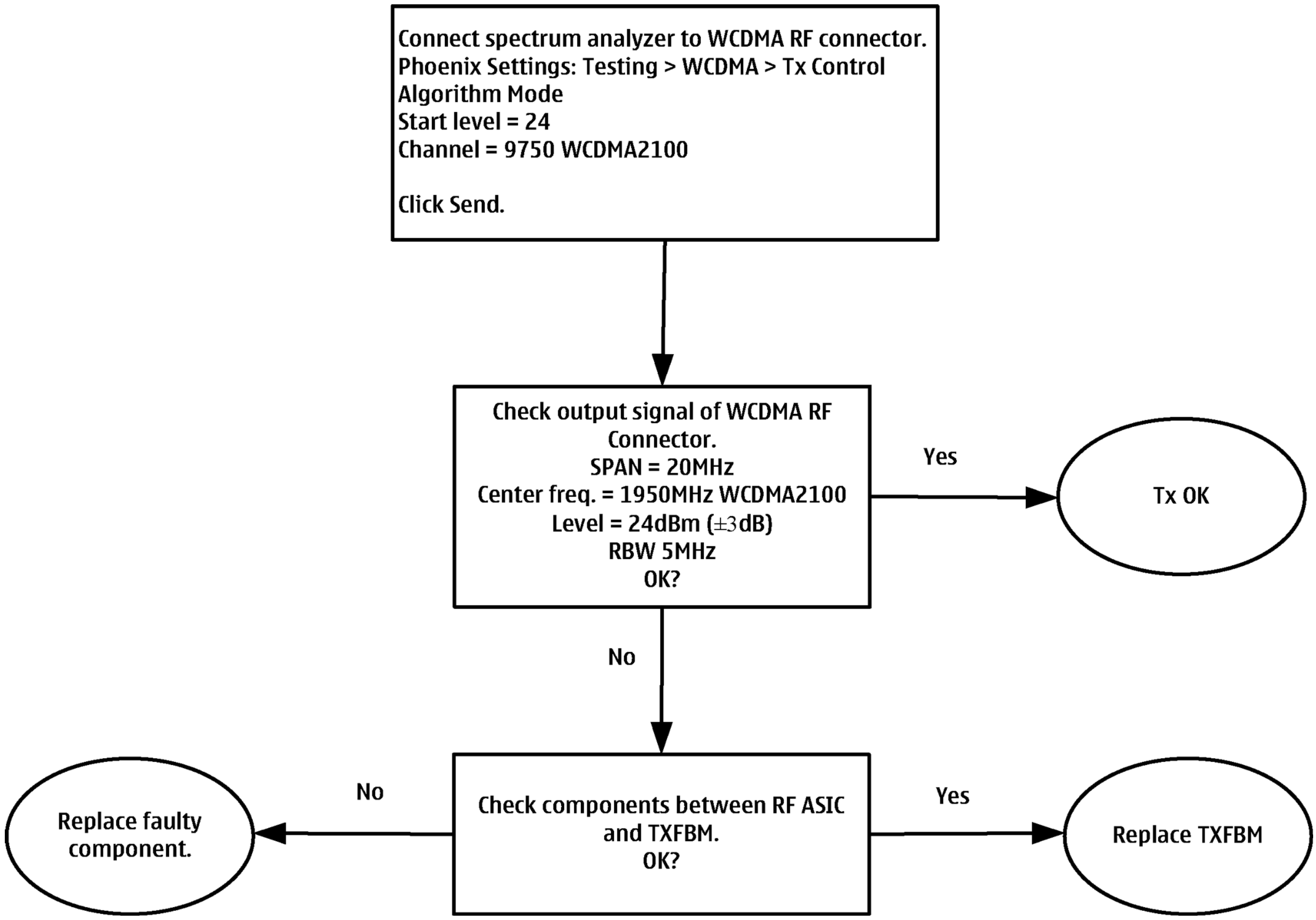
DPCCH
Code 0
Code class: 2
Weight: 8

4. Click **Send** to enable the settings and activate TX.

   If settings are changed (eg. new channel), you have to click **RF Stop** and **Send** again.

WCDMA transmitter troubleshooting flowchart

Troubleshooting flow


Connect spectrum analyzer to WCDMA RF connector.
Phoenix Settings: Testing > WCDMA > Tx Control
Algorithm Mode
Start level = 24
Channel = 9750 WCDMA2100
Click Send.
Check output signal of WCDMA RF Connector.
SPAN = 20MHz
Center freq. = 1950MHz WCDMA2100
Level = 24dBm (±3dB)
RBW 5MHz
OK?
Yes
Tx OK
No
Check components between RF ASIC and TXFBM.
OK?
No
Replace faulty component.
Yes
Replace TXFBM

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5 — Camera Module Troubleshooting

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    Bad image quality troubleshooting 5–9
    Flash troubleshooting 5–10
Secondary (front) camera troubleshooting flow 5–11
Accelerometer troublesooting 5–12

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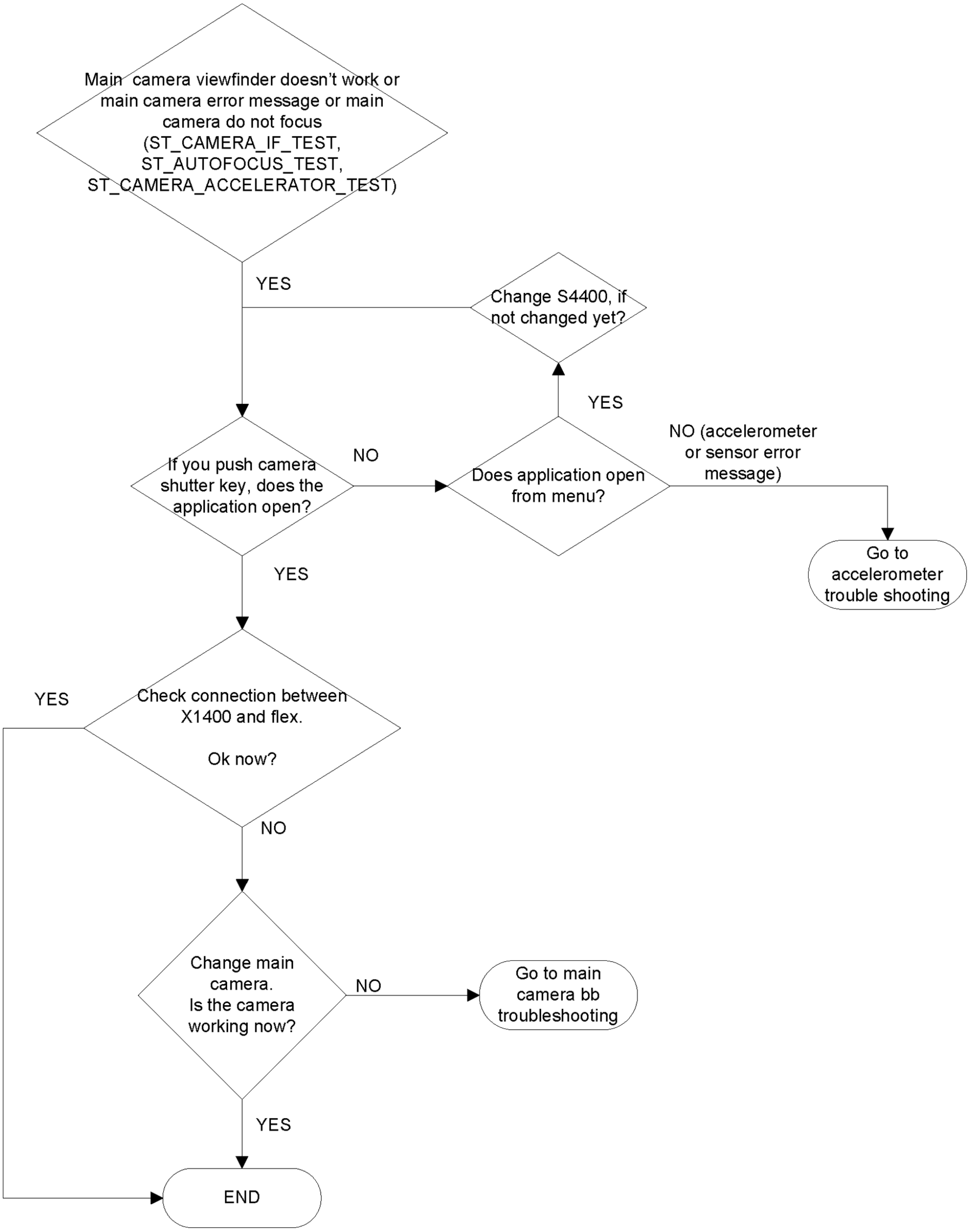
Main (back) camera troubleshooting

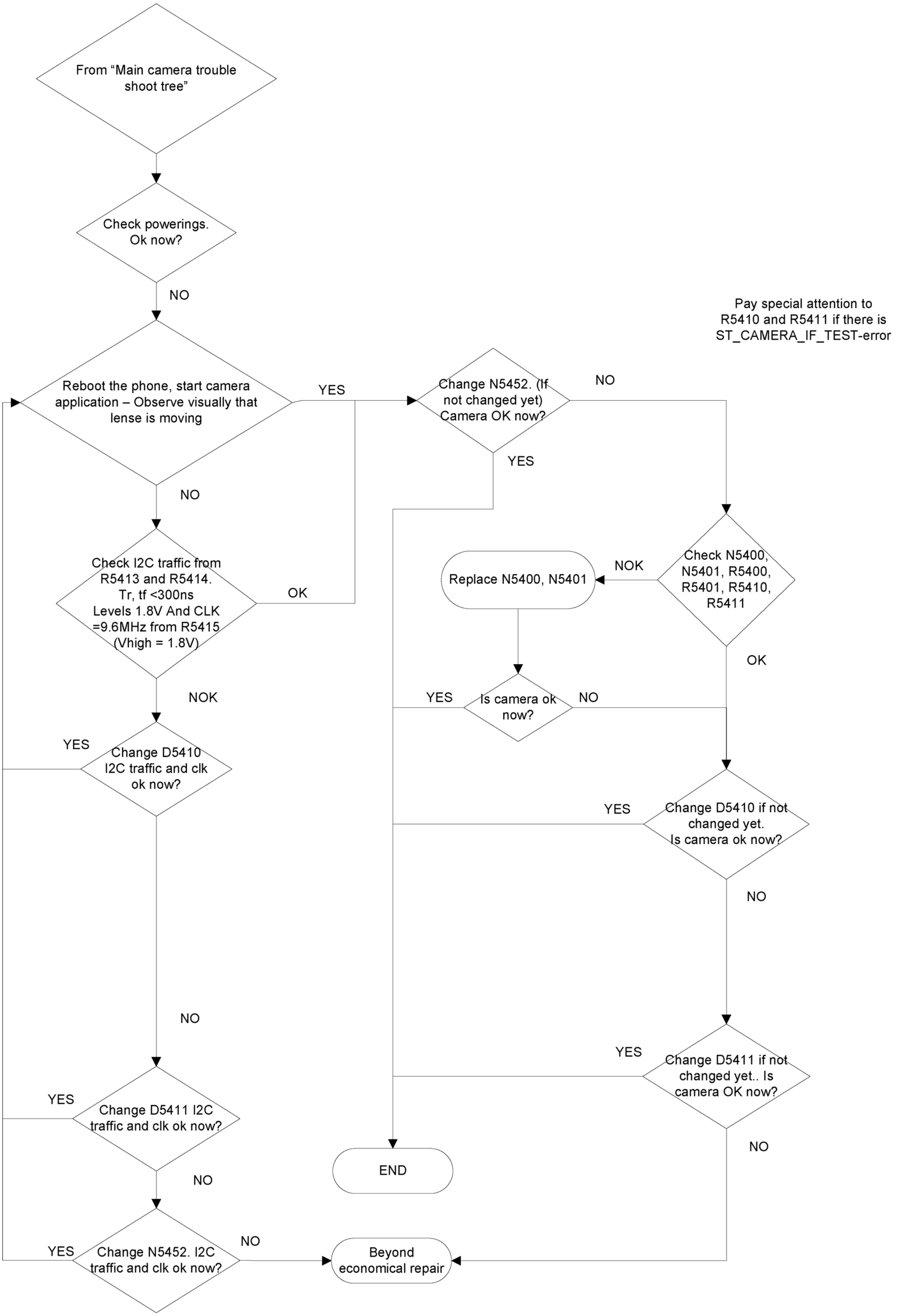
Main camera troubleshooting

Troubleshooting flow


Main camera viewfinder doesn't work or main camera error message or main camera do not focus (ST_CAMERA_IF_TEST, ST_AUTOFOCUS_TEST, ST_CAMERA_ACCELERATOR_TEST)
YES
Change S4400, if not changed yet?
YES
If you push camera shutter key, does the application open?
NO
Does application open from menu?
NO (accelerometer or sensor error message)
Go to accelerometer trouble shooting
YES
YES
Check connection between X1400 and flex.
Ok now?
NO
Change main camera. Is the camera working now?
NO
Go to main camera bb troubleshooting
YES
END

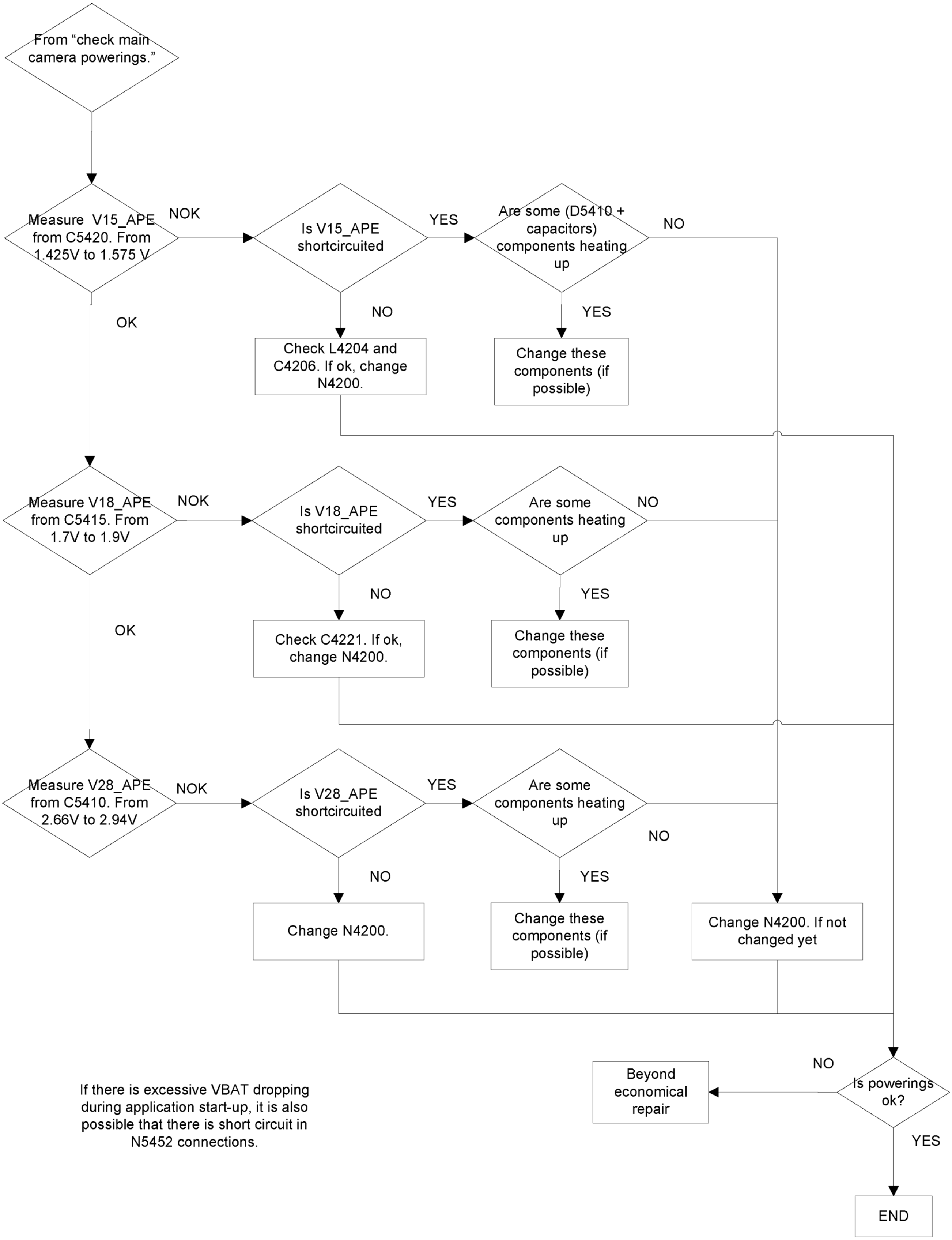
Main camera baseband troubleshooting

Troubleshooting flow


From "Main camera trouble shoot tree"
Check powerings. Ok now?
NO
Reboot the phone, start camera application – Observe visually that lense is moving
YES
NO
Check I2C traffic from R5413 and R5414. Tr, tf <300ns Levels 1.8V And CLK =9.6MHz from R5415 (Vhigh = 1.8V)
OK
NOK
Change D5410 I2C traffic and clk ok now?
YES
NO
Change D5411 I2C traffic and clk ok now?
YES
NO
Change N5452. I2C traffic and clk ok now?
YES
NO
Pay special attention to R5410 and R5411 if there is ST_CAMERA_IF_TEST-error
Change N5452. (If not changed yet) Camera OK now?
NO
YES
Check N5400, N5401, R5400, R5401, R5410, R5411
NOK
Replace N5400, N5401
OK
Is camera ok now?
YES
NO
Change D5410 if not changed yet. Is camera ok now?
YES
NO
Change D5411 if not changed yet.. Is camera OK now?
YES
NO
END
Beyond economical repair

Main camera baseband troubleshooting - powerings

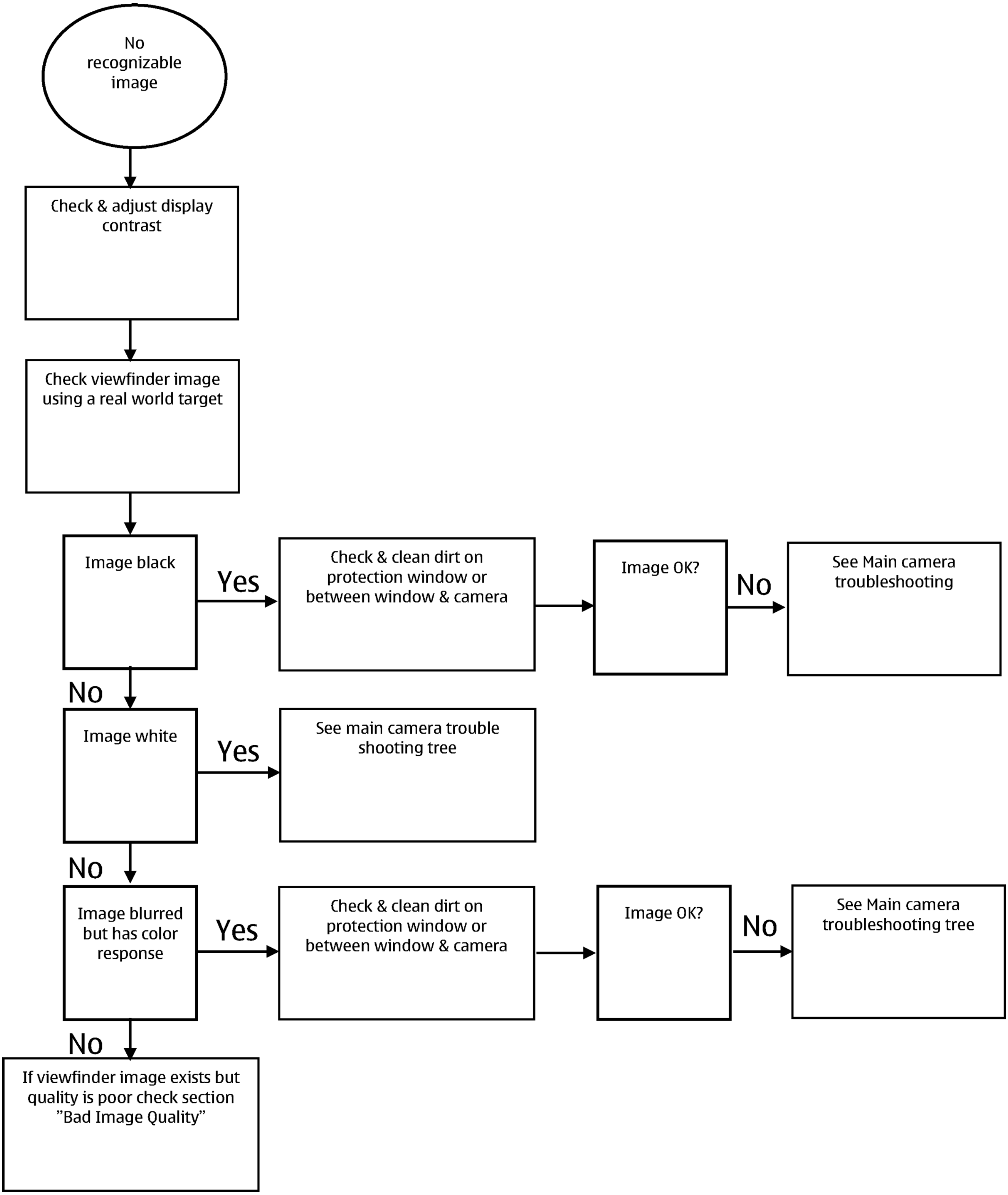
Troubleshooting flow


From "check main camera powerings."
Measure V15_APE from C5420. From 1.425V to 1.575 V
NOK
Is V15_APE shortcircuited
YES
Are some (D5410 + capacitors) components heating up
NO
NO
Check L4204 and C4206. If ok, change N4200.
YES
Change these components (if possible)
OK
Measure V18_APE from C5415. From 1.7V to 1.9V
NOK
Is V18_APE shortcircuited
YES
Are some components heating up
NO
NO
Check C4221. If ok, change N4200.
YES
Change these components (if possible)
OK
Measure V28_APE from C5410. From 2.66V to 2.94V
NOK
Is V28_APE shortcircuited
YES
Are some components heating up
NO
NO
Change N4200.
YES
Change these components (if possible)
Change N4200. If not changed yet
NO
Beyond economical repair
Is powerings ok?
YES
END

If there is excessive VBAT dropping during application start-up, it is also possible that there is short circuit in N5452 connections.

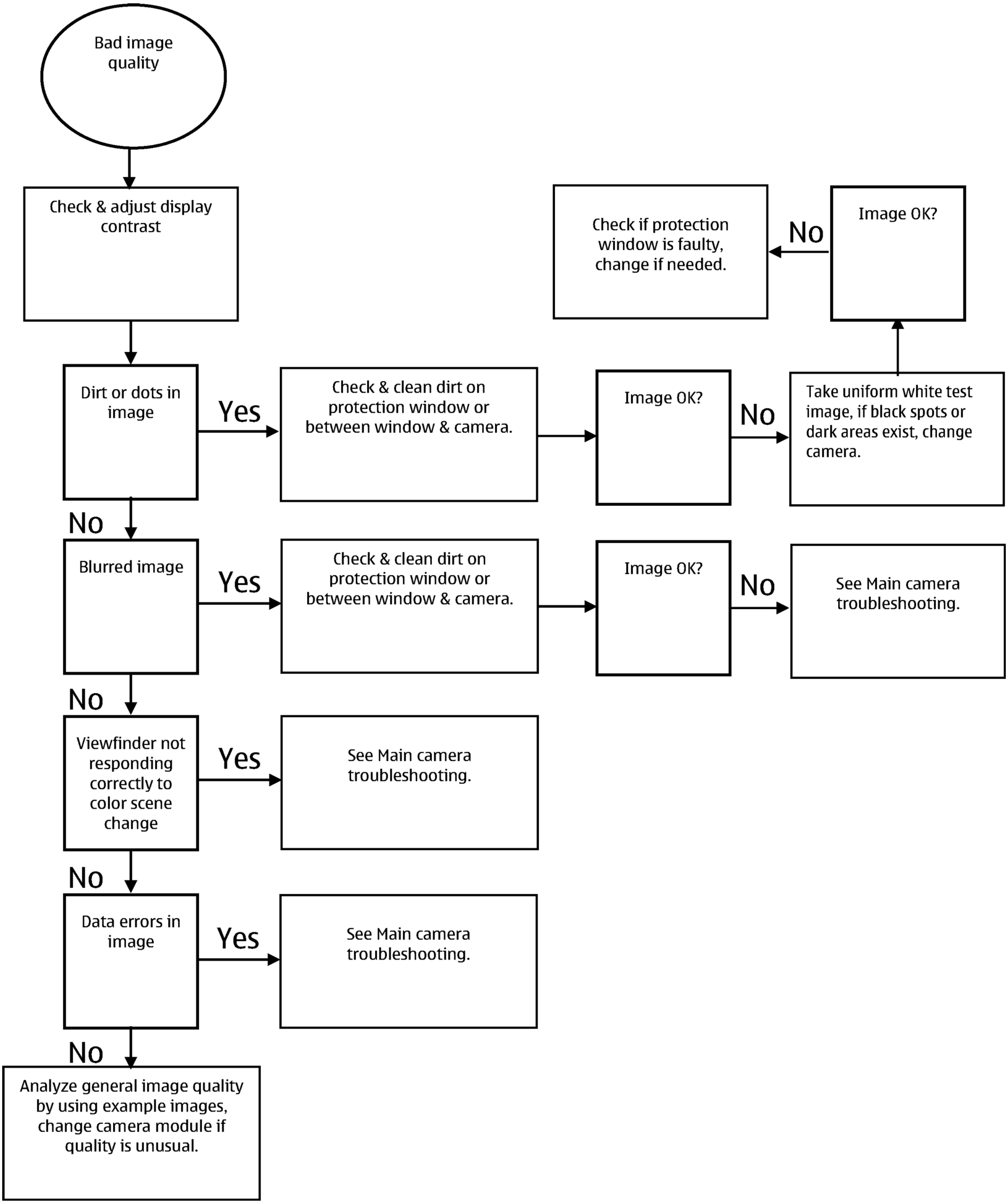
No recognizable viewfinder image

Troubleshooting flow


No recognizable image
Check & adjust display contrast
Check viewfinder image using a real world target
Image black
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
See Main camera troubleshooting
No
Image white
Yes
See main camera trouble shooting tree
No
Image blurred but has color response
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
See Main camera troubleshooting tree
No
If viewfinder image exists but quality is poor check section "Bad Image Quality"

Bad image quality troubleshooting

Troubleshooting flow

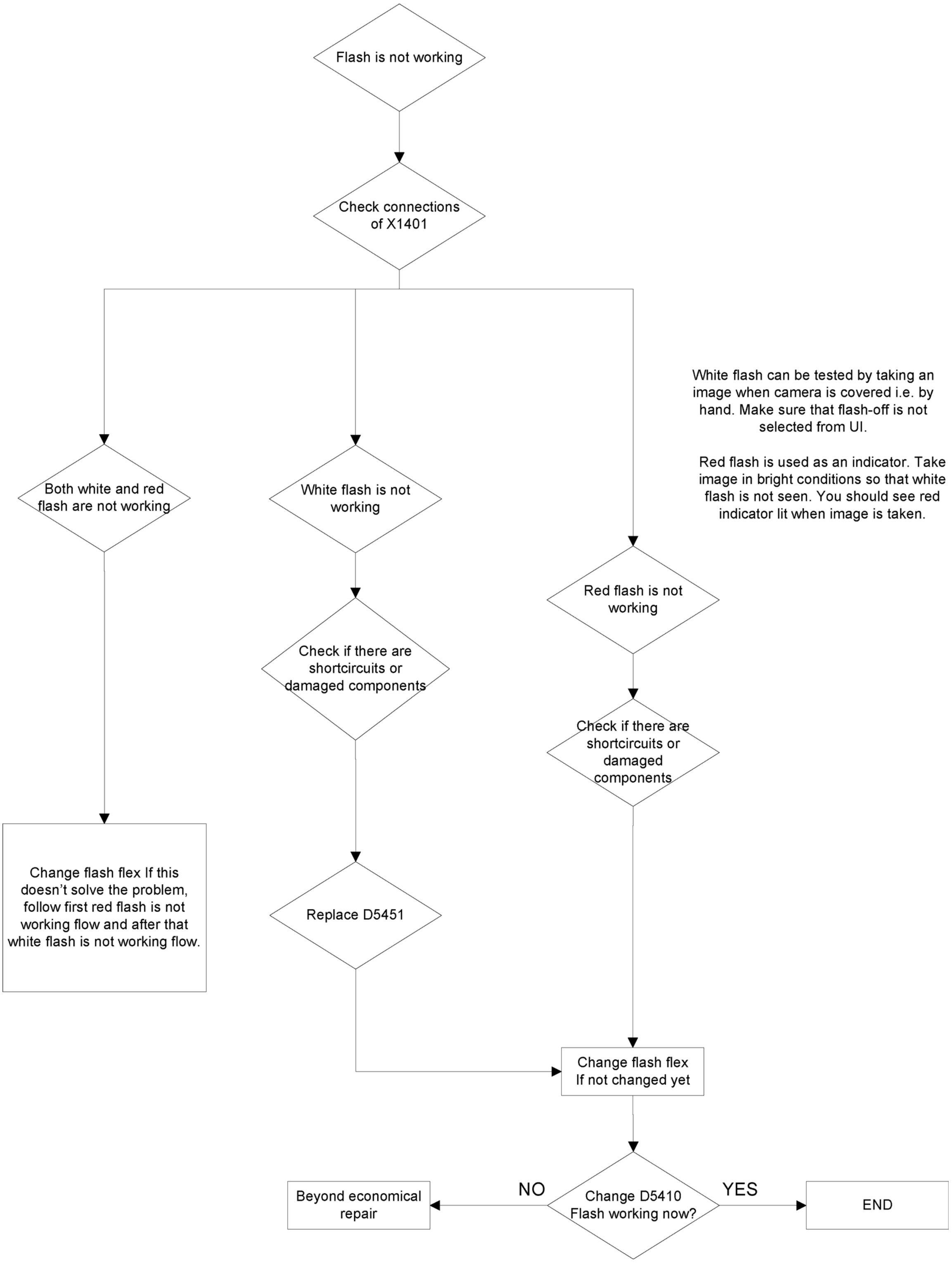

Bad image quality
Check & adjust display contrast
Dirt or dots in image
Yes
Check & clean dirt on protection window or between window & camera.
Image OK?
No
Take uniform white test image, if black spots or dark areas exist, change camera.
Image OK?
No
Check if protection window is faulty, change if needed.
No
Blurred image
Yes
Check & clean dirt on protection window or between window & camera.
Image OK?
No
See Main camera troubleshooting.
No
Viewfinder not responding correctly to color scene change
Yes
See Main camera troubleshooting.
No
Data errors in image
Yes
See Main camera troubleshooting.
No
Analyze general image quality by using example images, change camera module if quality is unusual.

Flash troubleshooting

Context

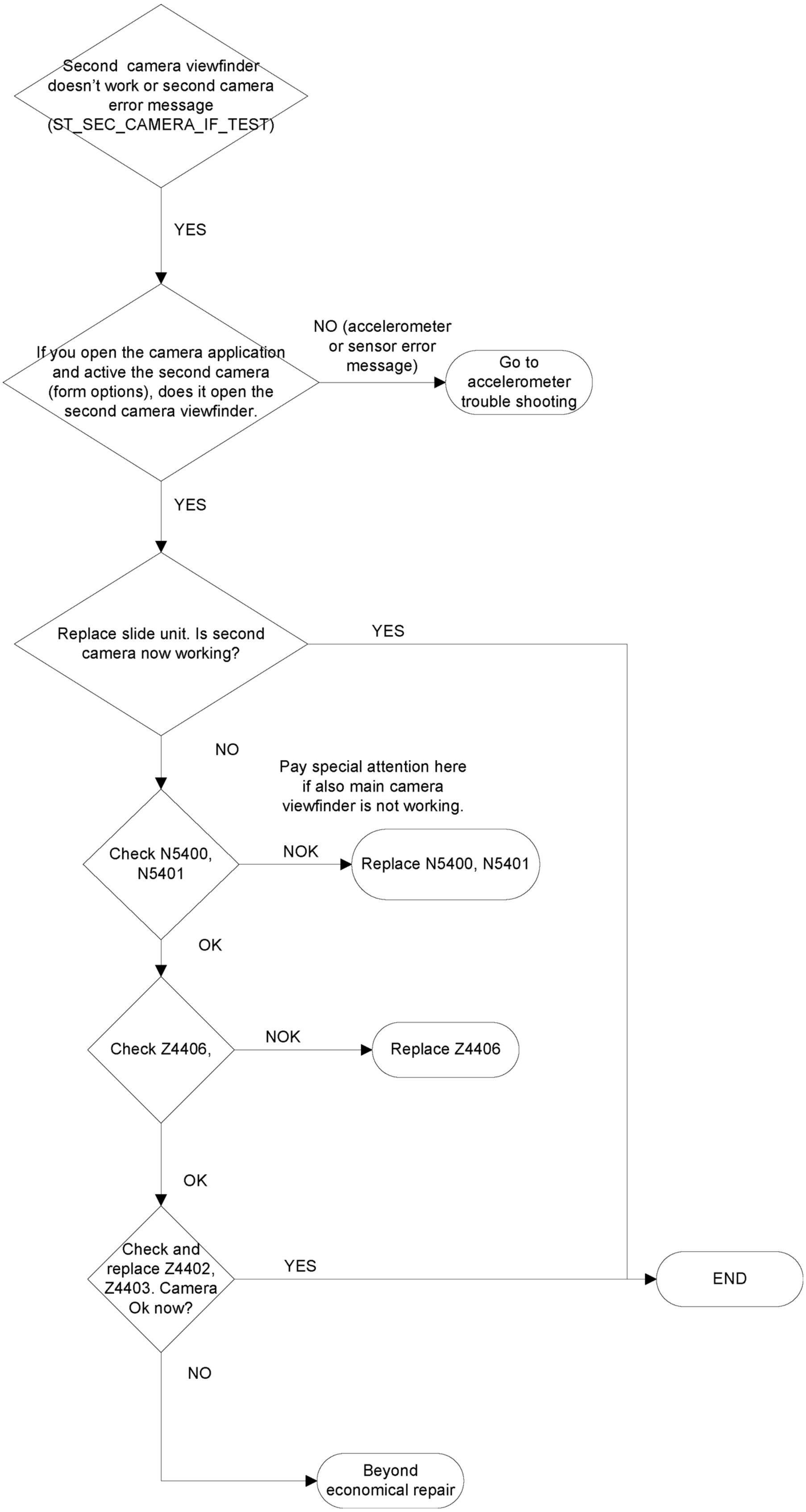
Note: Before checking flash functionality, make sure that the main camera is working ok.

Troubleshooting flow


Flash is not working
Check connections of X1401
Both white and red flash are not working
White flash is not working
Red flash is not working
White flash can be tested by taking an image when camera is covered i.e. by hand. Make sure that flash-off is not selected from UI.
Red flash is used as an indicator. Take image in bright conditions so that white flash is not seen. You should see red indicator lit when image is taken.
Check if there are shortcircuits or damaged components
Check if there are shortcircuits or damaged components
Change flash flex If this doesn't solve the problem, follow first red flash is not working flow and after that white flash is not working flow.
Replace D5451
Change flash flex If not changed yet
Change D5410 Flash working now?
NO
YES
Beyond economical repair
END

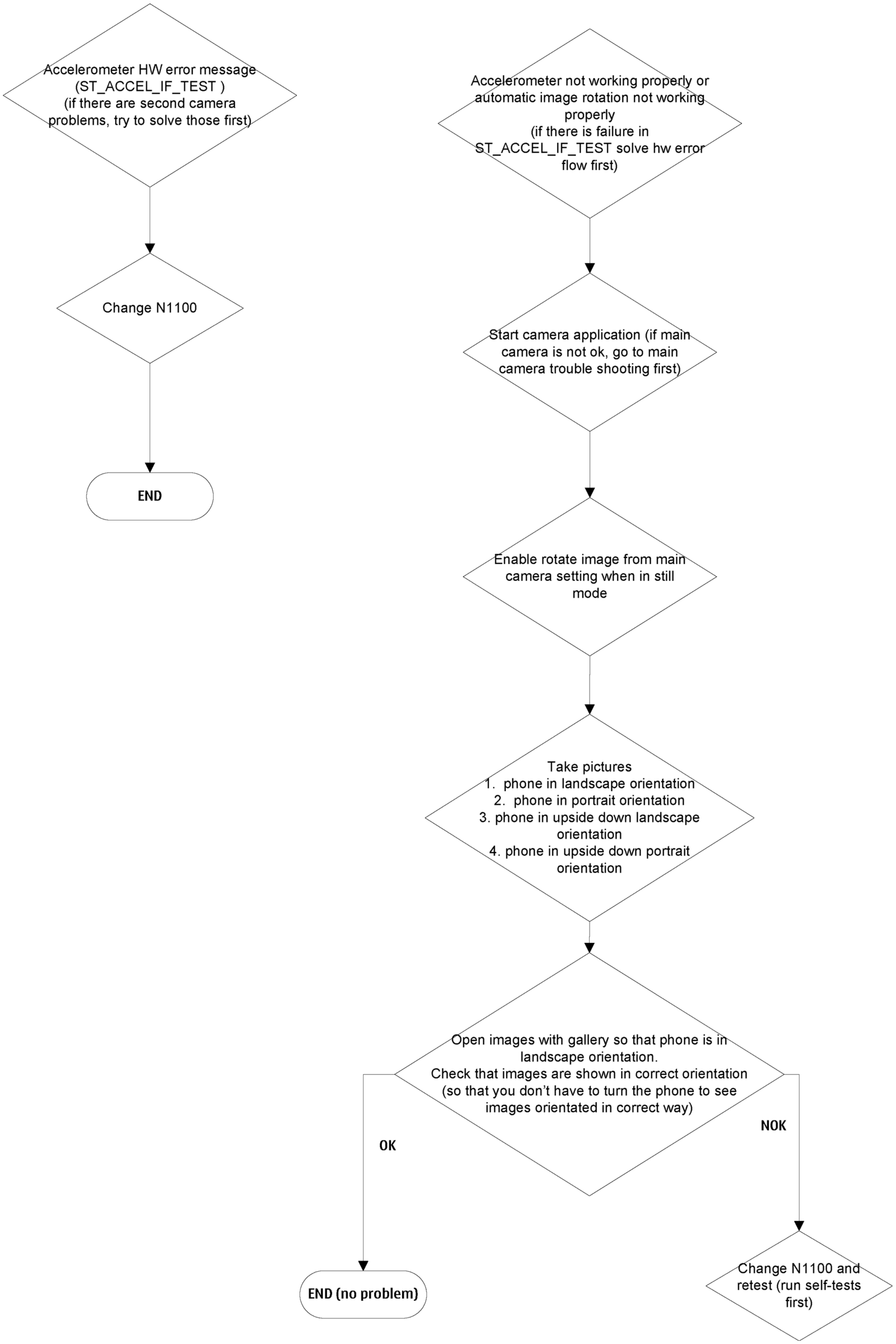
Secondary (front) camera troubleshooting flow

Troubleshooting flow


Second camera viewfinder doesn't work or second camera error message (ST_SEC_CAMERA_IF_TEST)
YES
If you open the camera application and active the second camera (form options), does it open the second camera viewfinder.
NO (accelerometer or sensor error message)
Go to accelerometer trouble shooting
YES
Replace slide unit. Is second camera now working?
YES
NO
Pay special attention here if also main camera viewfinder is not working.
Check N5400, N5401
NOK
Replace N5400, N5401
OK
Check Z4406,
NOK
Replace Z4406
OK
Check and replace Z4402, Z4403. Camera Ok now?
YES
END
NO
Beyond economical repair

Accelerometer troublesooting

Troubleshooting flow


Accelerometer HW error message (ST_ACCEL_IF_TEST) (if there are second camera problems, try to solve those first)
Change N1100
END
Accelerometer not working properly or automatic image rotation not working properly (if there is failure in ST_ACCEL_IF_TEST solve hw error flow first)
Start camera application (if main camera is not ok, go to main camera trouble shooting first)
Enable rotate image from main camera setting when in still mode
Take pictures
1. phone in landscape orientation
2. phone in portrait orientation
3. phone in upside down landscape orientation
4. phone in upside down portrait orientation
Open images with gallery so that phone is in landscape orientation. Check that images are shown in correct orientation (so that you don't have to turn the phone to see images orientated in correct way)
OK
NOK
END (no problem)
Change N1100 and retest (run self-tests first)

6 — System Module

(This page left intentionally blank.)

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Baseband description

System module block diagram

The device consists of two different main modules: transceiver and UI/slide module. The transceiver board consists of baseband and RF components. The UI/slide module consists of the display, UI-FPC and MM key module. Numeric keyboard is on the system/RF module.

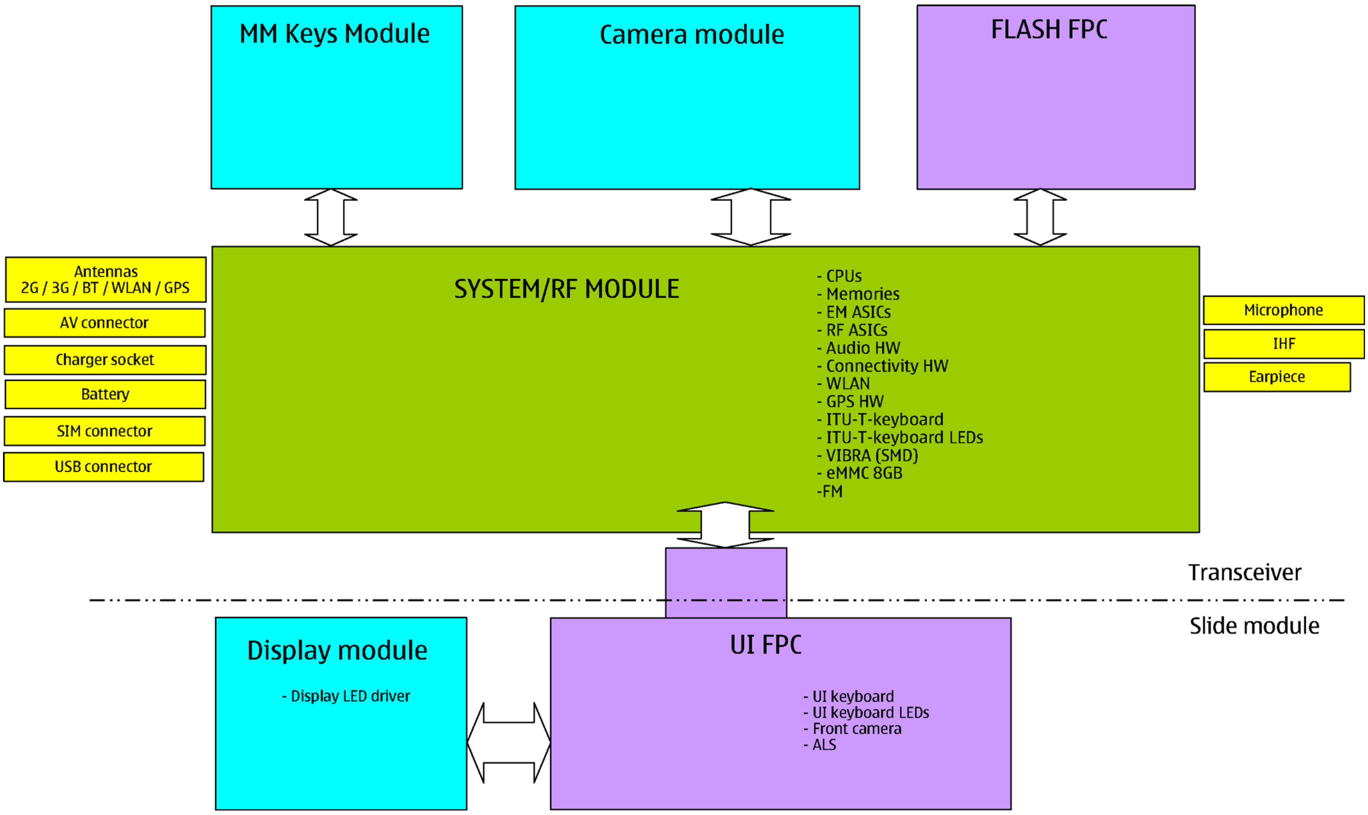

MM Keys Module
Camera module
FLASH FPC
Antennas
2G / 3G / BT / WLAN / GPS
AV connector
Charger socket
Battery
SIM connector
USB connector
SYSTEM/RF MODULE
- CPUs
- Memories
- EM ASICs
- RF ASICs
- Audio HW
- Connectivity HW
- WLAN
- GPS HW
- ITU-T-keyboard
- ITU-T-keyboard LEDs
- VIBRA (SMD)
- eMMC 8GB
-FM
Microphone
IHF
Earpiece
Transceiver
Slide module
Display module
- Display LED driver
UI FPC
- UI keyboard
- UI keyboard LEDs
- Front camera
- ALS

Figure 33 System level block diagram

Baseband functional description

Digital baseband consists of an ISA (Intelligent Software Architecture) based modem and Symbian based application sections. The modem functionality is in RAPIDOYawe and the application processor acts as a platform for Symbian applications.

The modem section consists of a RAPIDOYawe ASIC with combo memory (128Mbit NOR Flash + 128Mbit SDRAM) as the core. RAPIDOYawe supports WCDMA/HSDPA and GSM protocols. RAPIDOYawe operates with the 38.4MHz system clock, which comes from VCTCXO and provides 19.2MHz system clock to application processor.

The application section includes an application processor ASIC OMAP2420 with combo memory (1Gb DDR + 2Gb NAND) as the core. Combo memory is soldered Package-On-Package (POP) on top of OMAP2420.

Absolute maximum ratings

Signal	Min	Nom	Max	Unit	Notes
Battery voltage (idle)	-0.3		+4.5	V	Battery voltage maximum value is specified during charging is active

Signal	Min	Nom	Max	Unit	Notes
Battery voltage (Call)	+3.2		+4.3	V	Battery voltage maximum value is specified during charging is active
Charger input voltage	-0.3		+20	V	
Back-Up supply voltage	0	2.5	2.6	V	Maximum capacity of the backup power supply assumed to be 4 µAh.

Phone modes of operation

Mode	Description
NO_SUPPLY	(Dead) mode means that the main battery is not present or its voltage is too low (below EM ASIC N2200 master reset threshold) and that the back-up battery voltage is too low.
BACK_UP	The main battery is not present or its voltage is too low, but back-up battery voltage is adequate and the 32kHz oscillator is running (RTC is on).
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over EM ASIC N2200 master threshold. All regulators are disabled, PurX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off.
RESET	RESET mode is a synonym for start-up sequence. In this mode certain regulators are enabled and after they and RFClk have stabilized, the system reset (PurX) is released and PWR_ON mode entered. RESET mode uses 32kHz clock to count the REST mode delay (typically 16ms).
SLEEP	SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system activity is low. There are in principle three different sleep modes: • Application processor sleep • RAPIDO sleep • Application processor and RAPIDO sleep (deep sleep) In sleep mode N2200's regulators VIO, VDRAM, VSIM1 and VANA are in low quiescent current mode (output voltages still present but regulators will not give as much current out). VSIM2 is permanently off, and VAUX is always in the power on mode. Other regulators including VR1 supplying system clock oscillator are disabled. In SLEEP mode, N2390 VCore SMPS regulator is in low quiescent current mode. In SLEEP mode, N2300 EM ASIC linear regulator VOUT state depends on the accessory connected to the AV connector, if there is any.
FLASHING	FLASHING mode is for SW downloading.

Voltage limits

Parameter	Description	Value
VMSTR	Master reset threshold (N2200)	2.2V (typ.)
VMSTR+	Threshold for charging, rising (N2300)	2.1V (typ.)
VMSTR-	Threshold for charging, falling (N2300)	1.9V (typ.)

Parameter	Description	Value
VCOFF+	Hardware cutoff (rising)	2.9V (typ.)
VCOFF-	Hardware cutoff (falling)	2.6V (typ.)
SWCOFF	SW cutoff limit	~3.25V

The master reset threshold controls the internal reset of EM ASICs. If battery voltage is above VMSTR, N2300 charging control logic is alive. Also, RTC is active and supplied from the main battery. Above VMSTR, N2300 allows the system to be powered on although this may not succeed due to voltage drops during start up. SW can also consider battery voltage too low for operation and power down the system.

Power key

The system boots up, when power key is pressed (adequate battery voltage, VBAT, present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). Power key is connected to EM ASIC N2200 via PWRONX signal.

Power distribution

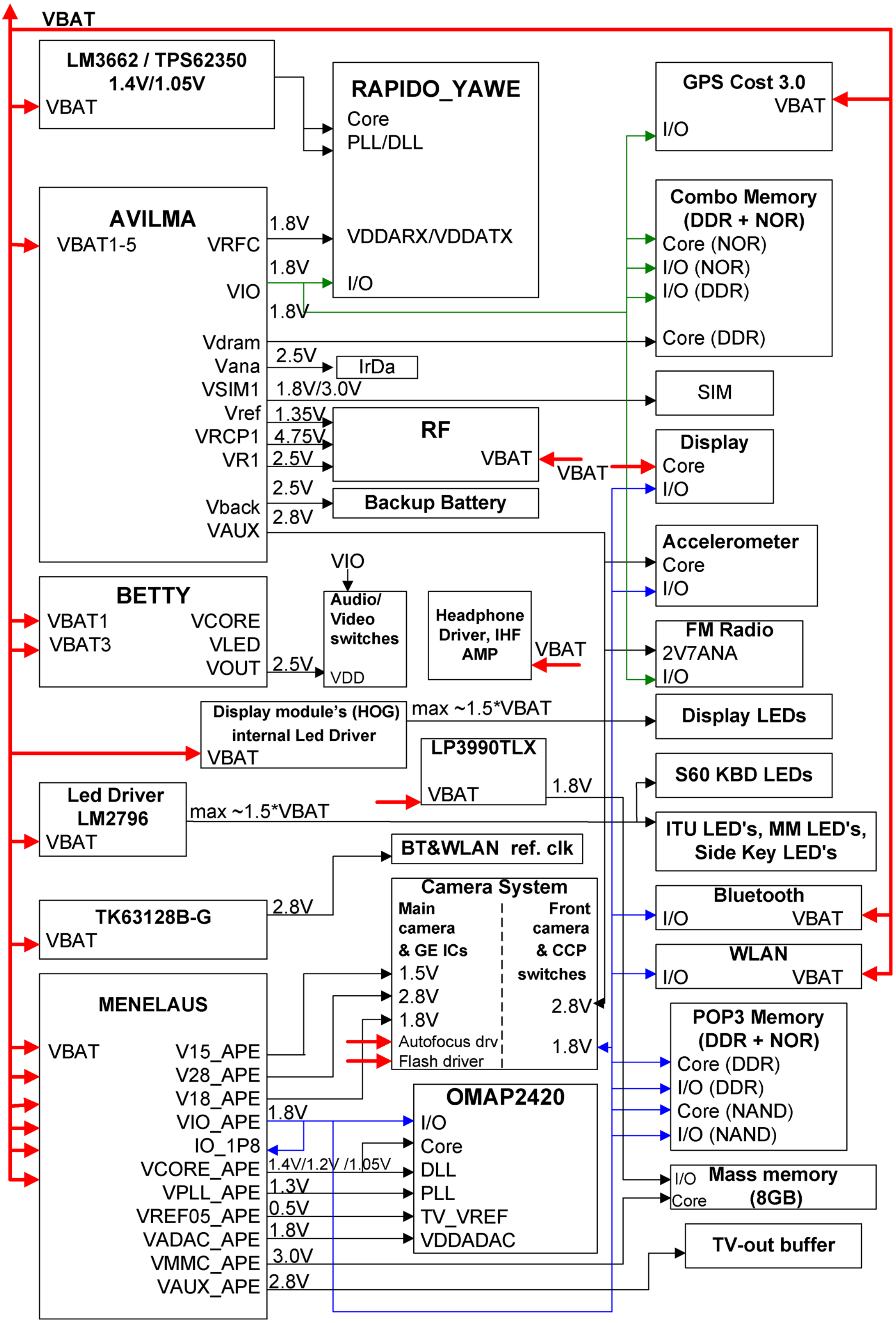

VBAT
LM3662 / TPS62350
1.4V/1.05V
VBAT
RAPIDO_YAWE
Core
PLL/DLL
VDDARX/VDDATX
I/O
GPS Cost 3.0
VBAT
I/O
Combo Memory
(DDR + NOR)
Core (NOR)
I/O (NOR)
I/O (DDR)
Core (DDR)
AVILMA
VBAT1-5
VRFC
VIO
Vdram
Vana
VSIM1
Vref
VRCP1
VR1
Vback
VAUX
1.8V
1.8V
1.8V
2.5V
1.8V/3.0V
1.35V
4.75V
2.5V
2.5V
2.8V
IrDa
SIM
RF
VBAT
VBAT
Display
Core
I/O
Backup Battery
Accelerometer
Core
I/O
VIO
BETTY
VBAT1
VBAT3
VCORE
VLED
VOUT
2.5V
Audio/ Video switches
VDD
Headphone Driver, IHF AMP
VBAT
FM Radio
2V7ANA
I/O
Display module's (HOG) internal Led Driver
VBAT
max ~1.5*VBAT
Display LEDs
LP3990TLX
VBAT
1.8V
S60 KBD LEDs
Led Driver LM2796
VBAT
max ~1.5*VBAT
ITU LED's, MM LED's, Side Key LED's
BT&WLAN ref. clk
TK63128B-G
VBAT
2.8V
Camera System
Main camera & GE ICs
Front camera & CCP switches
1.5V
2.8V
1.8V
Autofocus drv
Flash driver
2.8V
1.8V
Bluetooth
I/O
VBAT
WLAN
I/O
VBAT
MENELAUS
VBAT
V15_APE
V28_APE
V18_APE
VIO_APE
IO_1P8
VCORE_APE
VPLL_APE
VREF05_APE
VADAC_APE
VMMC_APE
VAUX_APE
1.8V
1.4V/1.2V /1.05V
1.3V
0.5V
1.8V
3.0V
2.8V
OMAP2420
I/O
Core
DLL
PLL
TV_VREF
VDDADAC
POP3 Memory
(DDR + NOR)
Core (DDR)
I/O (DDR)
Core (NAND)
I/O (NAND)
I/O
Core
Mass memory (8GB)
TV-out buffer

Figure 34 RM-320 power block diagram

System power-up

After inserting the main battery, regulators started by HW are enabled. SW checks, if there is some reason to keep the power on. If not, the system is set to power off state by watchdog. Power up can be caused by following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wakeup

CellMo engine (WG4.1M) is master during power up sequence i.e. CellMo side makes the decision when phone is powered on. RSTX signal from AVilma is used to enable the startup sequence of Rel3.1 engine. The rising edge of RSTX starts all the resources needed to boot RAPIDOYawe and OMAP2420 chips following the required sequence:

1. When a valid wake up event happens (power key press, charger detection, RTC alarm or voltage detected in MBUS line), AVILMA asserts RSTX signal high. RSTX enables the internal regulators of AVilma (VIO, VANA, VDRAM and VR1), Betty, Menelaus1 and the discrete SMPS for RAPIDOYawe core. VIO enables the AVilma’s internal 32kHz output buffer and VR1 starts the 38.4MHz VCTCXO on RF. Both 32kHz sleep clock and 38.4MHz RF clock start to run and are available in the system.
2. It takes max 0.65ms before Menelaus1 is ready to start the power-up sequence on the APE side. VIO_APE starts first. It supplies power for APE side memories and OMAP2420POP I/Os.
3. SysClkReq signal has an internal pull-up resistor to IO voltage (VIO_APE) of OMAP, so it follows the slope of VIO_APE. RAPIDOYawe activates the 19.2MHz system clock when it interprets SysClkReq as a logical 1. This happens when SysClkReq reaches about 1V level.
4. When VIO_APE has completed its power-up, it is possible to apply signals to OMAP I/Os. 32 kHz sleep clock is applied to OMAP.
5. When VIO_APE has completed its power-on sequence, the VCORE_APE is enabled and starts its ramp up sequence.
6. When VCORE_APE ramp up is complete, VPLL_APE starts ramping up.
7. When VPLL_APE has ramped up, the PWROK signal is asserted to signal that the OMAP2420 power-up sequence has been completed.
8. After a 16ms (typ) delay, the PURX signal is asserted high by AVILMA. Both CellMo and APE processors are released out of reset with this signal. SW can start the controlling of SW controllable regulators on the CellMo side.
9. OMAP2420POP completes its power-on sequence, and asserts nRESWARM high (after ~5x32kHz clock cycles) when it is completed.
10. SW can start the controlling of VMMC_APE, VAUX_APE, VADAC_APE, VDCDC3_APE, V18_APE and V28_APE regulators of M1 via the I2C interface.

Clocking scheme

There are two main clocks in the system:

- 38.4MHz RF clock produced by VCTCXO in RF section
- 32.768kHz sleep clock produced by the EM ASIC N2200 with an external crystal.

RF clock is generated only when VCTCXO is powered on by the EM ASIC regulator. The regulator itself is activated by SleepX signal from Rapido. When both CPU’s are on sleep, RF clock is stopped.

RF clock is used by RAPIDOYawe, which provides 19.2MHz SysClk to the application processor. Both RAPIDOYawe and OMAP2420 have internal PLL's that create clock signals for other peripheral devices/ interfaces like internal mass memory (eMMC), SIM, CCP, I2C and memories. BT and WLAN have their own 38.4MHz crystal oscillator that generates clock signal when clock is requested by WLAN or BT.

32k Sleep Clock is always powered on after startup. Sleep clock is used by RAPIDOYawe and the application processor for low power operation. Sleep clock is also used by GPS, FM Radio, Bluetooth and WLAN. RAPIDOYawe and GPS sleep clock is not buffered, for other modules sleep clock is buffered (VIO_APE is the buffer power supply).

SMPS Clk is a 2.4MHz clock line from RAPIDOYawe to EM ASIC N2300 and discrete SMPS N2390. In deep sleep VCTCXO is off and this signal is set to '0' state.

9.6MHz Camera Clock is generated by Golden Eye.

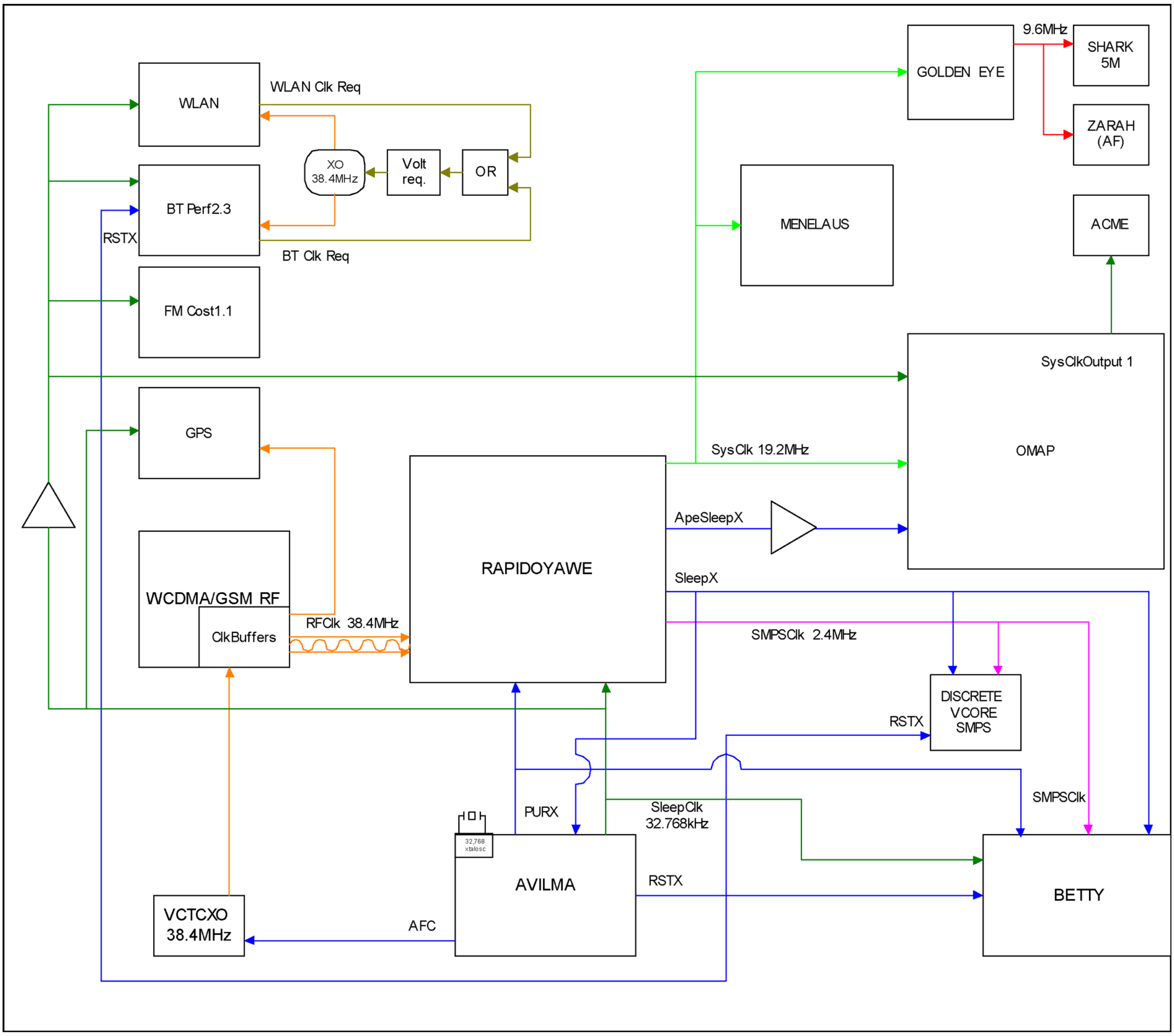

WLAN
WLAN Clk Req
XO 38.4MHz
Volt req.
OR
BT Perf2.3
RSTX
BT Clk Req
FM Cost1.1
GPS
WCDMA/GSM RF
ClkBuffers
RFClk 38.4MHz
RAPIDOYAWE
GOLDEN EYE
9.6MHz
SHARK 5M
ZARAH (AF)
MENELAUS
ACME
SysClkOutput 1
OMAP
SysClk 19.2MHz
ApeSleepX
SleepX
SMPSClk 2.4MHz
DISCRETE VCORE SMPS
RSTX
SMPSClk
32.768 xtalosc
PURX
SleepClk 32.768kHz
AVILMA
RSTX
BETTY
AFC
VCTCXO 38.4MHz

Figure 35 RM-320 clocking diagram

Bluetooth and FM radio

Bluetooth

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units. Data and control interface for a low power RF module is provided. This device supports Bluetooth 2.0 +EDR standard.

The Bluetooth module (N6030) is a single chip solution that uses common crystal oscillator (38.4 MHz) with WLAN module. BT has interfaces to modem ASIC D2800 (PCM for BT audio), application ASIC D4800 (UART for BT data) and to WLAN, which controls antenna usage.

FM radio

The FM radio is and integrated circuit, controlled by MCU software through a serial bus interface. The wires of the headset are used as poles of the antenna, and no other antenna is needed for FM radio reception. The FM radio utilizes the AV connector for its antenna connectivity. The RF input of the FM radio module is connected to the stereo audio output pins (HS_EAR_L/R) via RF coupling circuitry. Wired headset connected to the AV connector works as an antenna for FM radio. The FM radio is controlled by I2C commands from RAPIDO. The audio output of the FM radio (N6157) is fed to the headset via EM ASIC N2200.

Bluetooth and FM radio block diagram

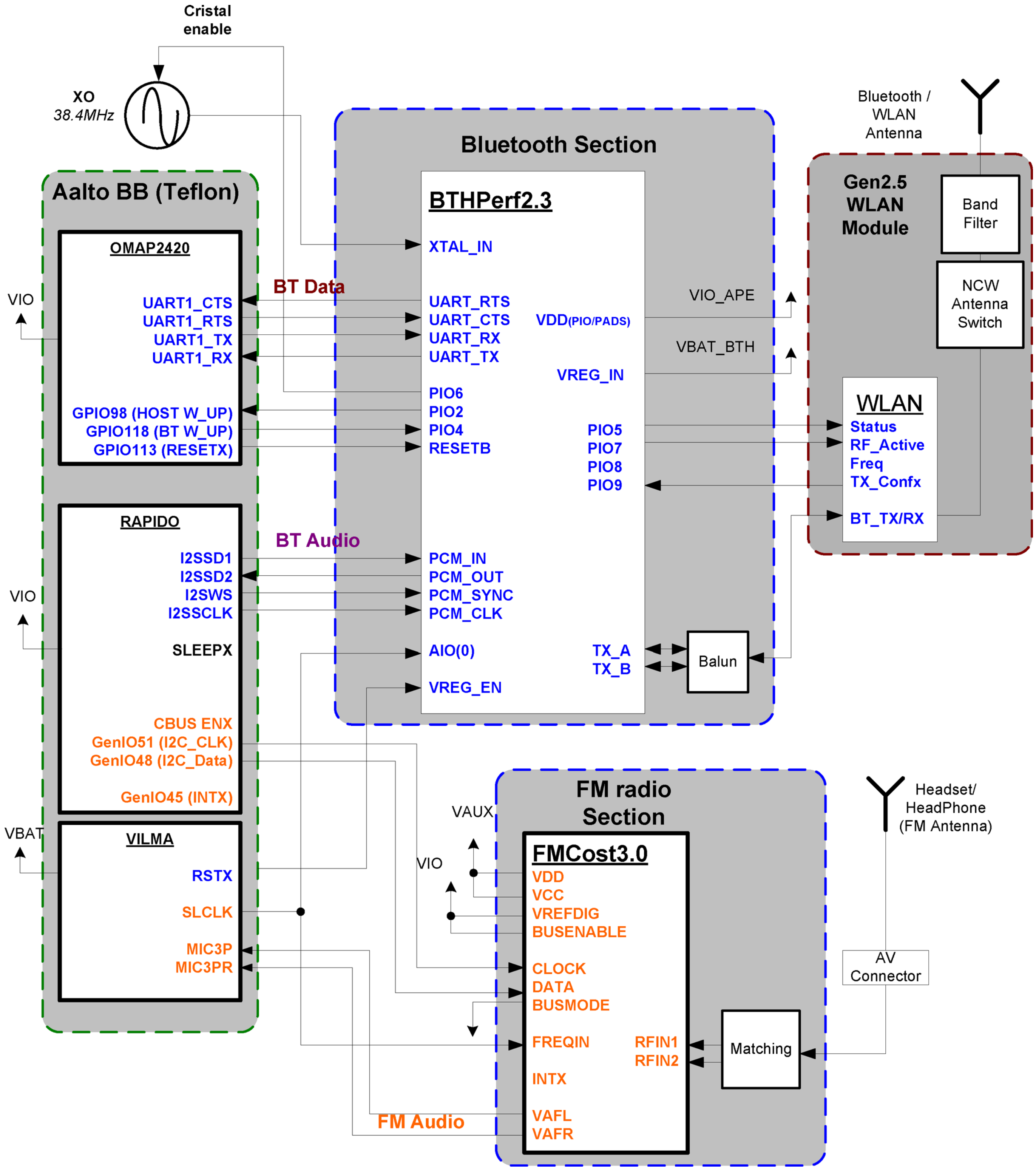

Cristal
enable
XO
38.4MHz
Aalto BB (Teflon)
OMAP2420
VIO
UART1_CTS
UART1_RTS
UART1_TX
UART1_RX
GPIO98 (HOST W_UP)
GPIO118 (BT W_UP)
GPIO113 (RESETX)
BT Data
RAPIDO
VIO
I2SSD1
I2SSD2
I2SWS
I2SSCLK
SLEEPX
CBUS ENX
GenIO51 (I2C_CLK)
GenIO48 (I2C_Data)
GenIO45 (INTX)
BT Audio
VBAT
VILMA
RSTX
SLCLK
MIC3P
MIC3PR
Bluetooth Section
BTHPerf2.3
XTAL_IN
UART_RTS
UART_CTS
UART_RX
UART_TX
PIO6
PIO2
PIO4
RESETB
PCM_IN
PCM_OUT
PCM_SYNC
PCM_CLK
AIO(0)
VREG_EN
VDD(PIO/PADS)
VREG_IN
PIO5
PIO7
PIO8
PIO9
TX_A
TX_B
Balun
VIO_APE
VBAT_BTH
Bluetooth /
WLAN
Antenna
Gen2.5
WLAN
Module
Band
Filter
NCW
Antenna
Switch
WLAN
Status
RF_Active
Freq
TX_Confx
BT_TX/RX
FM radio
Section
VAUX
VIO
FMCost3.0
VDD
VCC
VREFDIG
BUSENABLE
CLOCK
DATA
BUSMODE
FREQIN
INTX
VAFL
VAFR
RFIN1
RFIN2
Matching
FM Audio
Headset/
HeadPhone
(FM Antenna)
AV
Connector

Figure 36 Bluetooth and FM radio block diagram

WLAN

WLAN engine is divided into STLC4550 WLAN transceiver module and radio front-end module (FEM) RF5924.

STMicroelectronics Phaser STLC4550 is a three-die multichip module, partitioned to radio, baseband and energy management die. STLC4550 is packaged to 8.5 mm x 8.0 mm x 1.4 mm 240-ball 0.5 mm pitch LFBGA.

STLC4550 implements 802.11b/g WLAN radio for embedded, low-power and small form factor mobile applications. STLC4550 conforms to the IEEE 802.11b/g protocols operating in 2.4 GHz band supporting OFDM data rates of 54, 48, 36, 24, 18, 12, 9, and 6 Mbps as well as CCK data rates of 11 and 5.5 Mbps and legacy data rates of 2 and 1 Mbps. IEEE802.11e/i protocol extensions are included to implement quality of service (QoS) and security functions.

STLC4550 has a fully integrated radio chip including a direct-conversion transceiver, RF synthesizer and VCO, and high-speed data converters. Digital interface is used for transferring the sampled data between radio and baseband chip. The baseband chip implements OFDM/CCK digital baseband processor and ARM9- based MAC with internal SRAM memories. The baseband includes required logic and interfaces to enable time-shared simultaneous use of BT and WLAN.

The energy management unit integrates required power management functions to operate the system from VBAT (3.0 – 5.5 V). The EM unit generates 1.2 V digital core voltage, two 1.8 V supplies for RF and 2.8 V LDO for PA bias supply. The EM unit also integrates power-on reset circuitry and level-shifters for RF front-end GaAs switches.

Host interface is provided by a flexible serial interface (SPI) supporting clock frequency upto 48 MHz. The maximum usable SPI clock rate depends on the host side clocking options and timing requirements. Typically rates of 14 – 24 MHz are achieved. WLAN/BT coexistence interface enables automatic time shared usage of WLAN and Bluetooth.

The system uses 38.4 MHz reference clock. In this device, a dedicated oscillator circuit for WLAN and bluetooth reference clock is used. Low power sleep mode operation is enabled using 32768Hz low speed clock and energy management stand-by state.

WLAN RFMD RF5924 front end module is used. Power amplifier, RF-switches and baluns are integrated to FEM. The PA includes power detector for closed-loop power control purposes. WLAN/BT bandpass filter is external ceramic filter.

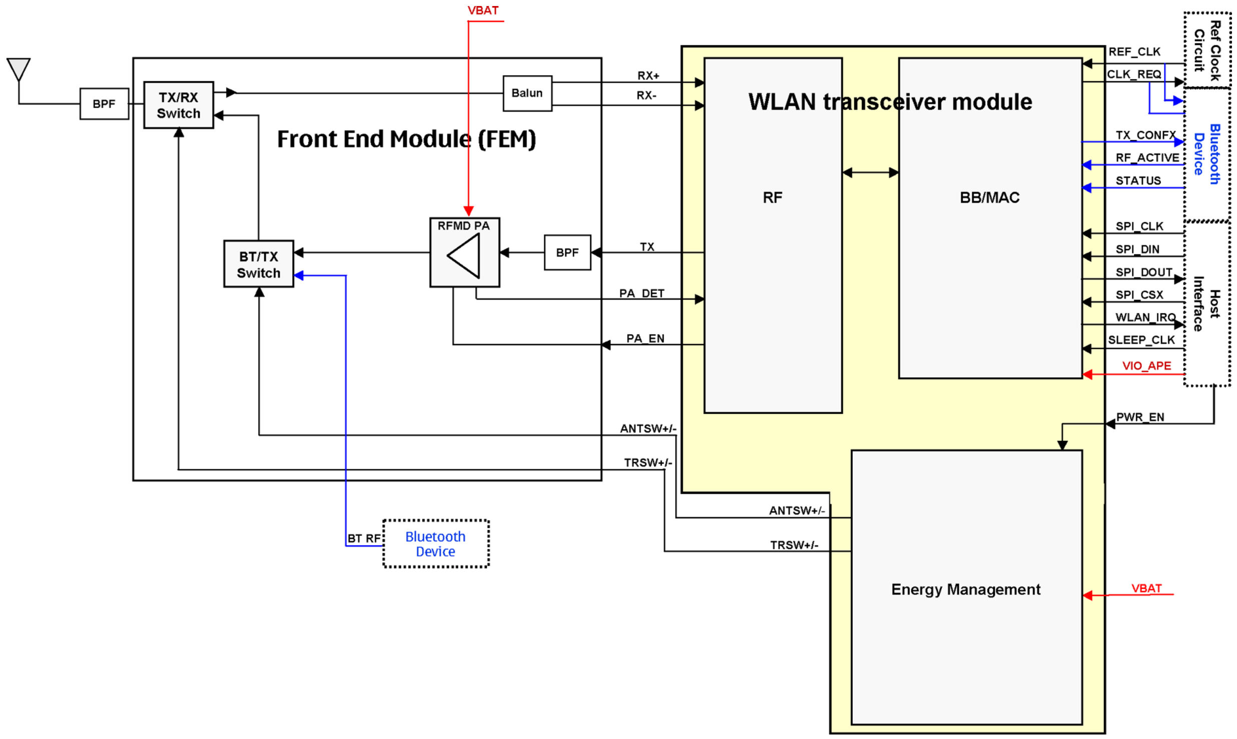

VBAT
BPF
TX/RX Switch
Balun
RX+
RX-
Front End Module (FEM)
RFMD PA
BPF
BT/TX Switch
TX
PA_DET
PA_EN
ANTSW+/-
TRSW+/-
BT RF
Bluetooth Device
WLAN transceiver module
RF
BB/MAC
REF_CLK
CLK_REQ
Ref Clock Circuit
TX_CONFX
RF_ACTIVE
STATUS
Bluetooth Device
SPI_CLK
SPI_DIN
SPI_DOUT
SPI_CSX
WLAN_IRQ
SLEEP_CLK
VIO_APE
Host Interface
PWR_EN
ANTSW+/-
TRSW+/-
Energy Management
VBAT

Table 12 General WLAN specifications

Supported channels	**USA 1-11 (2412-2462MHz)**
	ETSI 1-13 (2412-2472MHz)
Transmitter power Barker/CCK (1, 2, 5.5, 11Mbps datarate) OFDM-BPSK(6, 9 Mb/s) OFDM-QPSK(12,18 Mb/s) OFDM-16QAM (24, 36 Mb/s) OFDM-64QAM (48,54 Mb/s)	17dBm 15dBm 15dBm 13dbm 13dBm
Power control range	0-17dBm
Receiver sensitivity (typical) 11M/bits. 1024bytes / 8% PER 54 Mb/s, 1000 bytes, 10% PER	-83dBm -70dBm

GPS interface

The device includes an inbuilt GPS receiver and it works as a stand-alone positioning device. The antenna is located below the main keypad in the bottom of the product.

The GPS system is connected to RAPIDO ASIC.

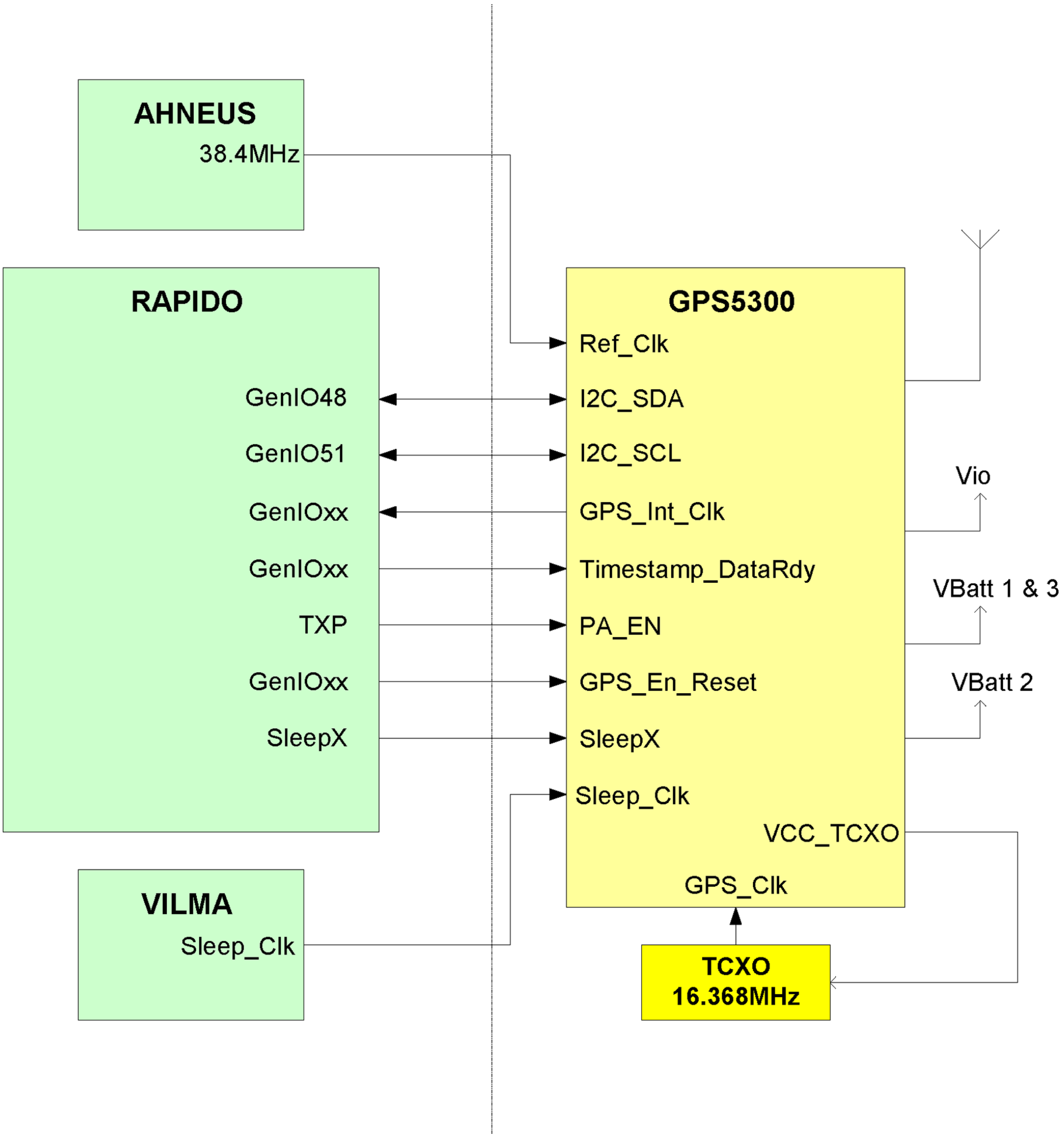

AHNEUS
38.4MHz
RAPIDO
GenIO48
GenIO51
GenIOxx
GenIOxx
TXP
GenIOxx
SleepX
VILMA
Sleep_Clk
GPS5300
Ref_Clk
I2C_SDA
I2C_SCL
GPS_Int_Clk
Timestamp_DataRdy
PA_EN
GPS_En_Reset
SleepX
Sleep_Clk
VCC_TCXO
GPS_Clk
Vio
VBatt 1 & 3
VBatt 2
TCXO
16.368MHz

Figure 37 Block diagram of the GPS system

USB

The device supports USB 2.0 full speed, with mini-USB connector.

USB connection is implemented using the Application ASIC D4800 USB controller interface and N2300 EM ASIC's USB transceiver. External interface is the mini-B connector. The interface between N2300 transceiver and mini-B receptacle is standard USB interface specified Universal Serial Bus specification Rev. 2.0. The USB transfers signal and power over four-wire interface. Interface carries differential data, Vbus and GND. Signalling occurs over differential data line, D+ and D-. The clock is transmitted, encoded along with the differential data. ESD protection is done with USB ASIP. VBUS (+5V) is provided by the host device.

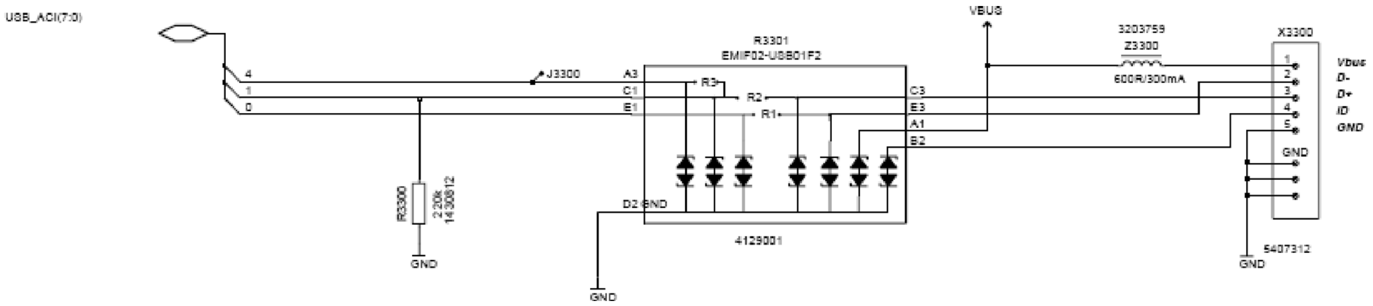

USB_ACI(7:0)
4
1
0
J3300
R3300
220k
1430812
GND
R3301
EMIF02-USB01F2
A3
C1
E1
R3
R2
R1
C3
E3
A1
B2
D2 GND
4129001
GND
VBUS
3203759
Z3300
600R/300mA
X3300
1
2
3
4
5
GND
Vbus
D-
D+
ID
GND
5407312
GND

Figure 38 USB connection between N2300 and mini-USB connector

Irda interface

The device supports SIR (slow IR), as specified in IrDA 1.4 specification. Baud rate is 9600 bit/s; this data is sent asynchronously. The IrDA module is controlled by application ASIC D4800. Basic HW connection is shown below.

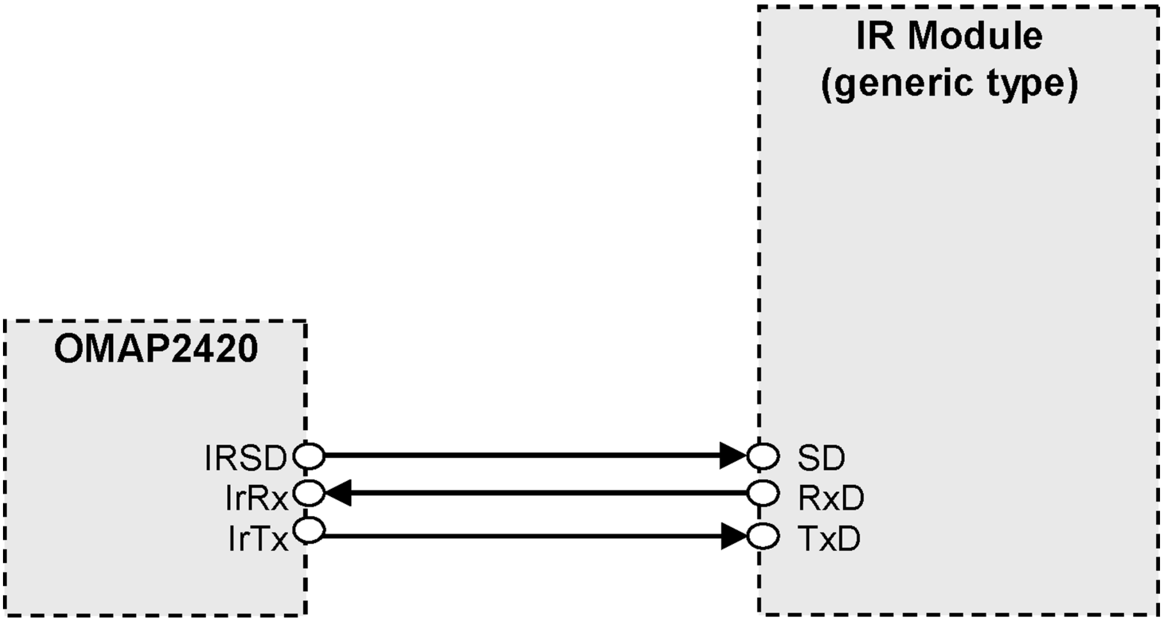

IR Module
(generic type)
OMAP2420
IRSD
IrRx
IrTx
SD
RxD
TxD

Figure 39 IrDA connection

SIM interface

The SIM (Subscriber Identification Module) interface is located in two ASICs; Cellular Modem ASIC D2800 contains most of the interface functionality and the mixed signal ASIC N2200 takes care of power up/down, card detect, ATR counting and level shifting. ESD protection components are integrated to N2200 ASIP.

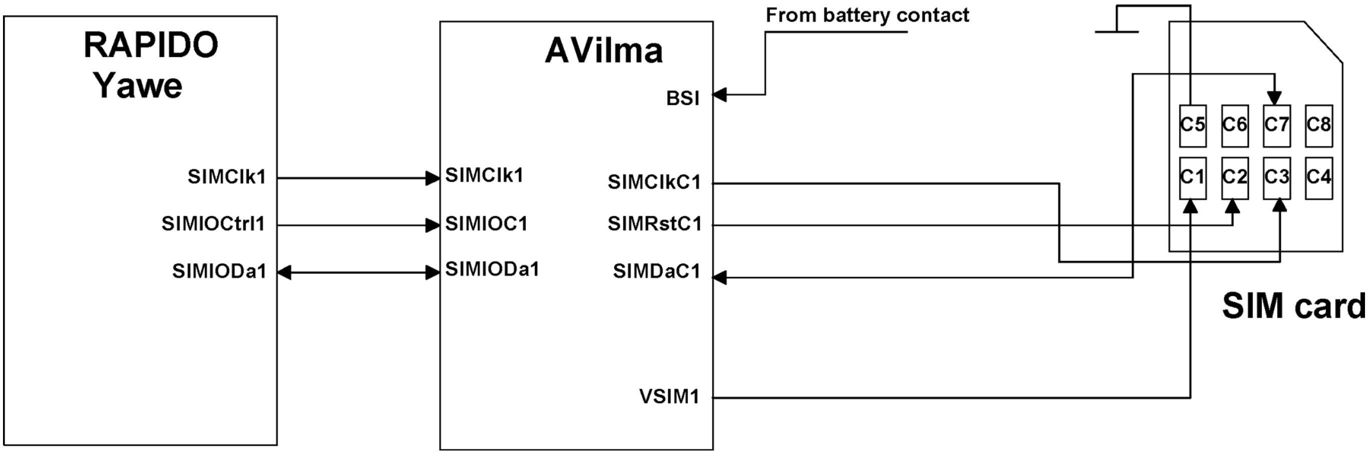

RAPIDO
Yawe
SIMClk1
SIMIOCtrl1
SIMIODa1
AVilma
BSI
SIMClk1
SIMIOC1
SIMIODa1
SIMClkC1
SIMRstC1
SIMDaC1
VSIM1
From battery contact
C5
C6
C7
C8
C1
C2
C3
C4
SIM card

Figure 40 SIM interface

Internal mass memory interface

Internal mass memory called eMMC is a BGA-packaged FLASH with HS-MMC interface. The eMMC component is connected to Menelaus (N4200) in module PWB. Block diagram of the eMMC design can be seen from the following figure. The eMMC memory interface is compliant with the MultiMediaCard Specification version 4.x.

The host in the eMMC interface is application ASIC D4800. eMMC transceiver/level shifter is in application side mixed signal IC (N4200). There are four data signals, one command signal and a clock output signal going in N4200. For transceiver control there are direction signals to each data signals and one also for CMD. A feedback clock is coming from transceiver to host. The eMMC transceiver is controlled by D4800 I2C_APE. Clock frequency used in device is 24MHz.

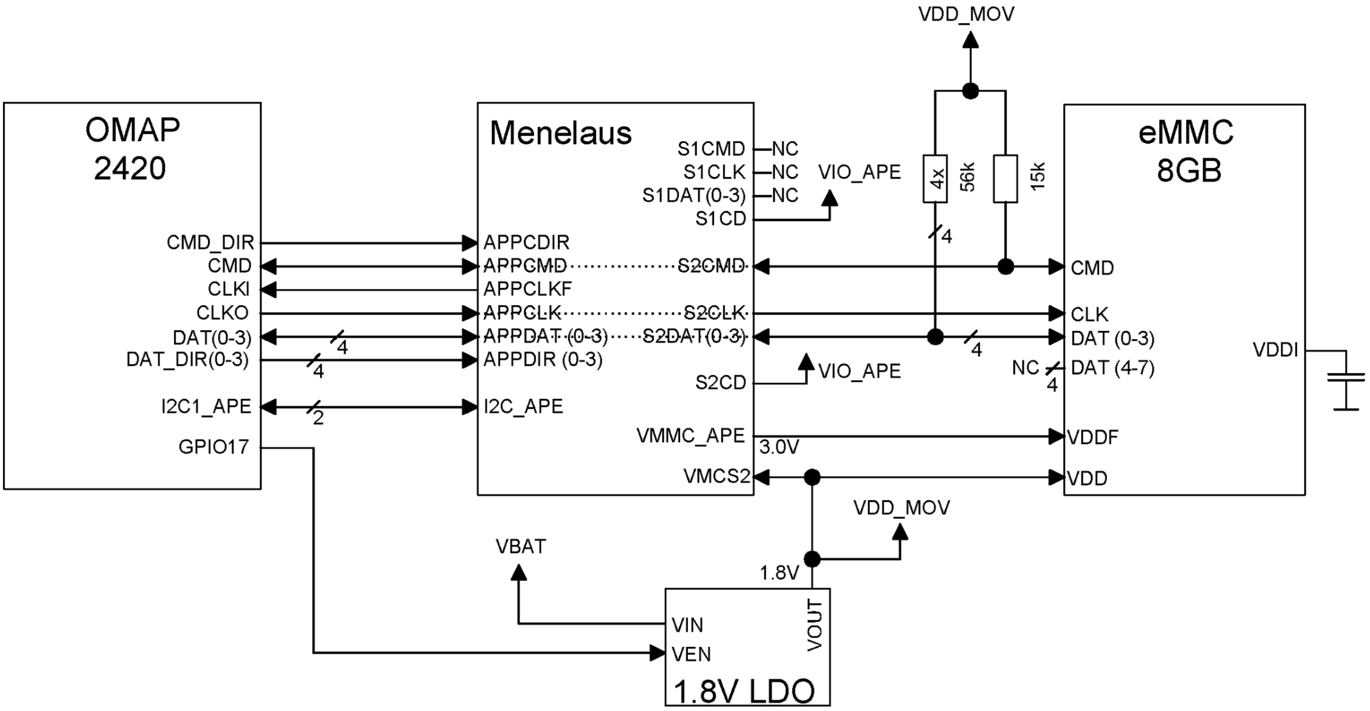

VDD_MOV
OMAP
2420
CMD_DIR
CMD
CLKI
CLKO
DAT(0-3)
DAT_DIR(0-3)
I2C1_APE
GPIO17
4
4
2
Menelaus
S1CMD
S1CLK
S1DAT(0-3)
S1CD
NC
NC
NC
VIO_APE
APPCDIR
APPCMD
APPCLKF
APPCLK
APPDAT (0-3)
APPDIR (0-3)
I2C_APE
S2CMD
S2CLK
S2DAT(0-3)
S2CD
VIO_APE
VMMC_APE
VMCS2
3.0V
4x
56k
15k
4
4
NC
4
eMMC
8GB
CMD
CLK
DAT (0-3)
DAT (4-7)
VDDI
VDDF
VDD
VDD_MOV
VBAT
1.8V
VIN
VEN
VOUT
1.8V LDO

Figure 41 eMMC interface

TV-out interface

A TV-out connection is implemented using the application processor (D4800) Video DAC interface and an external analogue line driver (N5650). The device engine supports the following systems using composite video (CVBS):

- M/NTSC
- J/NTSC
- 4.43/NTSC
- M/PAL
- N/PAL
- Nc/PAL
- B/PAL
- G/PAL
- D/PAL
- H/PAL
- I/PAL

CVBS is a single video signal containing all the necessary information to reproduce a colour picture. The video signal is filtered with ASIP R5650, and connected to AV-connector pin 3. Switch N2002 is used to connect AV connector pin 3 to TV-out, the same pin is used also as a microphone line.

Battery interface

The device uses 3-pole BL-6F battery. SW recognizes the battery manufacturer from BSI resistor value which is 100k for BL-6F (Sanyo).

Charging

Charging is controlled by different blocks depending on the situation: If battery is totally empty, the charging is controlled by CHACON block in N2300 and the battery is first charged with constant current until the voltage rises above certain limit (VMSTR+). Then the digital part of N2300 takes care of the charging and PWM charging is done until PURX is released. After this SW starts to control the charging.

The device has a Li-Ion battery, which has a protection circuit that limits the lowest battery voltage to 2.8V, and constant current mode is practically never used.

Camera interfaces

Camera system

The device's camera system consists of camera processor, which is connected to the application processor. The camera processor has external SDRAM and it used N5452 IC to control AF and mechanical shutter. The main camera and flash driver is connected to the camera processor. The front camera (second camera) is connected to application processor and it shares the CCP-bus with the camera processor through switches N5400 and 5401.

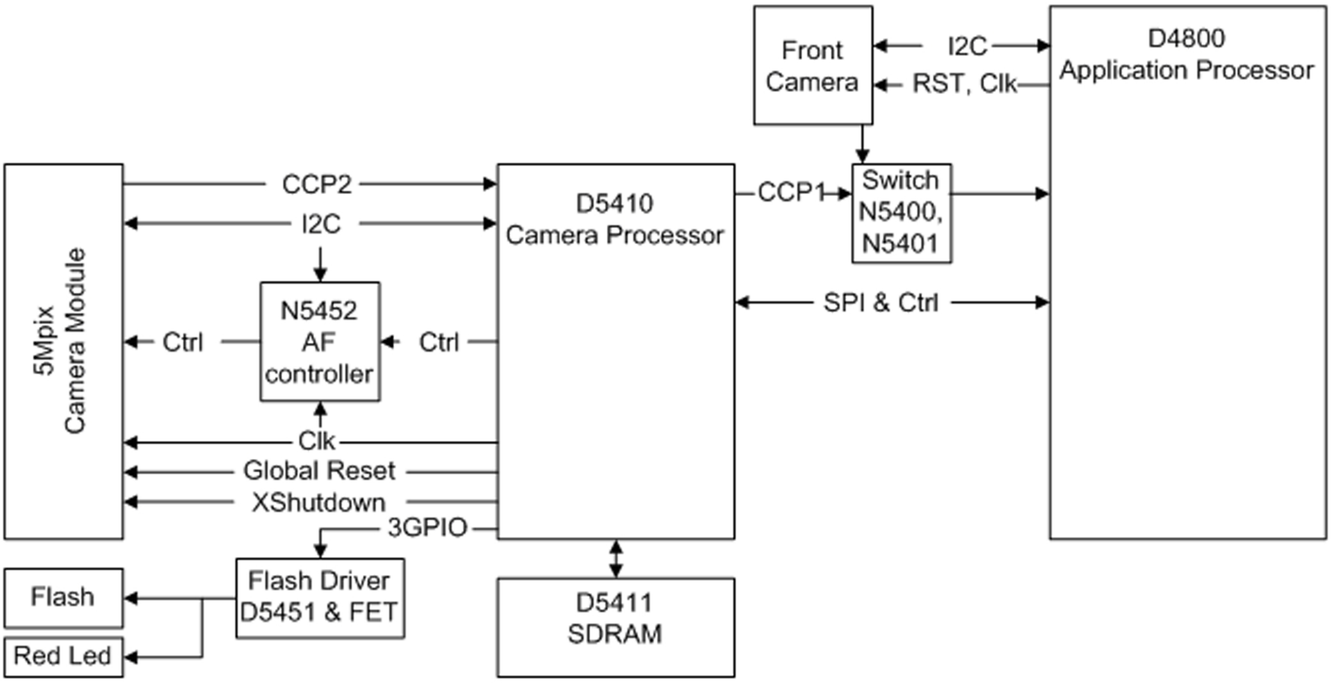

Front
Camera
I2C
RST, Clk
D4800
Application Processor
CCP2
I2C
D5410
Camera Processor
CCP1
Switch
N5400,
N5401
5Mpix
Camera Module
N5452
AF
controller
Ctrl
Ctrl
SPI & Ctrl
Clk
Global Reset
XShutdown
3GPIO
Flash
Red Led
Flash Driver
D5451 & FET
D5411
SDRAM

Figure 42 Camera system block diagram

Main camera characteristics

Sensor type	CMOS
Sensor photo detectors	5.0 million (2592 x 1944 pixels)
F number/Aperture	f/2.8
Focal length	5.6/35 mm (35 mm equal)
Focus range	10 cm to infinity
Still Image resolutions	up to 5 Megapixel: 2592x1944
Still images file format	EXIF (JPEG), *.jpg
Video resolutions	VGA 640 x 480 at 30 fps/15 fps 320 x 240 (QVGA) at 30/15 fps 176 x 144 at 15 fps (QCIF)
Video clip length	Maximal clip length is 60 mins (High or Normal quality) or limited to MMS size approx. 30 seconds (Sharing quality) **Note:** Clip length is dependable on available memory
Video file format	.mp4 (default) and .3gp (for MMS)
Auto exposure	Center weighted AE
White balance	Automatic, sunny, cloudy, incandescent, flurescent
Colour tones	Normal, sepia, vivid, black&white, negative
Capture Modes	Still capture mode, video mode and sequence mode
Selftimer	2, 10, or 20 secs

Flash settings	Auto, off, forced, anti red-eye
Automatic image rotation	On / Off

Camera flash

The device has also camera flash located directly beside the main camera, providing better image quality in darker environments. The flash consists of high power white LED and red LED, which are located on flash flex. The flex is connected to the main PWB through connector.

The red indicator is used as a privacy indicator. It is lit during video recording and it is also used to indicate image capture with the main camera. The white LED is used as a still flash and also as an auto-focus assistant light.

The flash lens, which ensures a proper light pattern at the target, is integrated into product mechanics.

Secondary camera characteristics

Sensor type	CMOS
Sensor Photo detectors	CIF
F number/Aperture	f/2.8
Focal length	43 mm (35mm equivalent)
Focus range	10 cm to infinity
Still Image resolutions	QVGA
Still images file format	JPEG/EXIF

Accelerometer

The device has an accelerometer, which used in automatic image rotation. Accelerometer is connected to application processor through I^{2}C bus. Image rotation has build-in hysteresis.

Audio concept

Audio HW architecture

The functional core of the audio hardware is built around two ASIC's: Cellular Modem ASIC D2800 and the mixed signal EM ASIC N2200.

There are four audio transducers:

- Dynamic earpiece (part of UI/Slide module)
- 2 Dynamic speakers
- Electret microphone

In addition to the audio transducers, N2200 also provides an output for the dynamic Vibra component. All galvanic audio accessories are connected to the AV-connector. Bluetooth audio module, that is connected to Cellular Modem ASIC D2800 supports Bluetooth audio functionality. For some audio applications, part of the processing is done on application processor ASIC D4800, for example for Music Player.

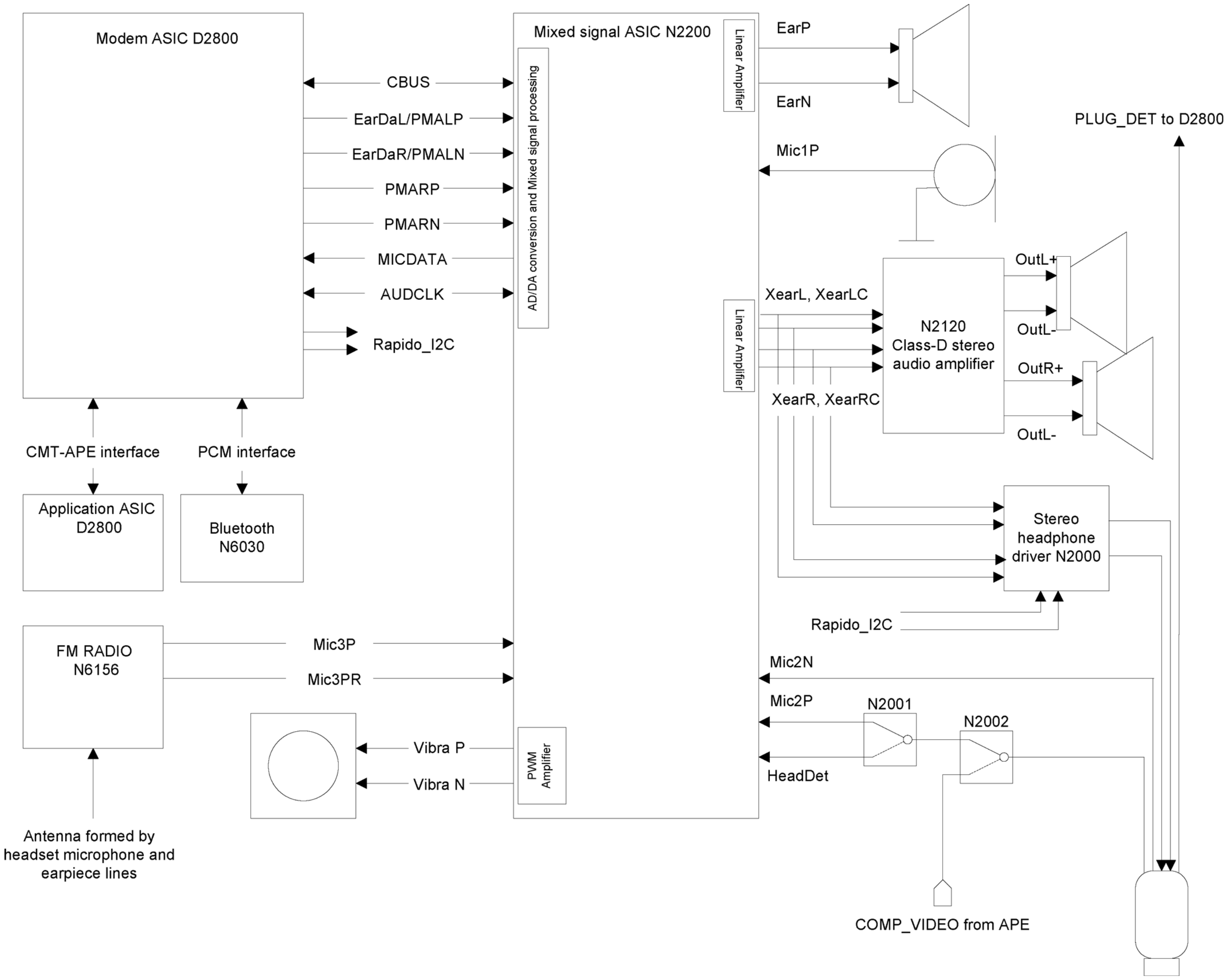
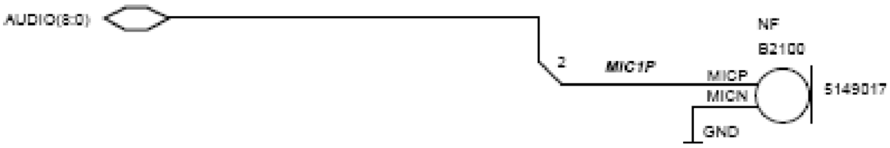

Modem ASIC D2800
Mixed signal ASIC N2200
AD/DA conversion and Mixed signal processing
Linear Amplifier
CBUS
EarDaL/PMALP
EarDaR/PMALN
PMARP
PMARN
MICDATA
AUDCLK
Rapido_I2C
EarP
EarN
Mic1P
PLUG_DET to D2800
XearL, XearLC
Linear Amplifier
N2120
Class-D stereo
audio amplifier
OutL+
OutL-
OutR+
OutL-
XearR, XearRC
CMT-APE interface
PCM interface
Application ASIC
D2800
Bluetooth
N6030
Stereo
headphone
driver N2000
Rapido_I2C
FM RADIO
N6156
Mic3P
Mic3PR
Mic2N
Mic2P
N2001
N2002
Vibra P
Vibra N
PWM
Amplifier
HeadDet
Antenna formed by
headset microphone and
earpiece lines
COMP_VIDEO from APE

Figure 43 Audio block diagram

Internal microphone

The internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes. Also if the accessory headset does not have microphone, the phone uses the internal microphone. An analogue electret microphone is connected to the EM ASIC N2200 Mic1P input via asymmetric electrical connection. The microphone is biased by the EM ASIC MicB1 bias voltage output.


AUDIO(8:0)
2
MIC1P
NF
B2100
MICP
MICN
GND
5149017

External microphone

Galvanic accessories are connected to the 3.5mm AV-connector. Accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories. External microphone is connected to EM ASIC N2200 input Mic2P and Mic2N. Mic2P, Head_Det line of EM ASIC N2200 and Composite Video input from application ASIC are multiplexed to the same AV-connector line.

Internal earpiece

The internal earpiece is used in the HandPortable (HP) call mode. A dynamic 8 mm earpiece capsule is connected directly to the EM ASIC (N2200) differential outputs EarP and EarN through the flip flexi PWB and micro coaxial cable (X6 - X8900).

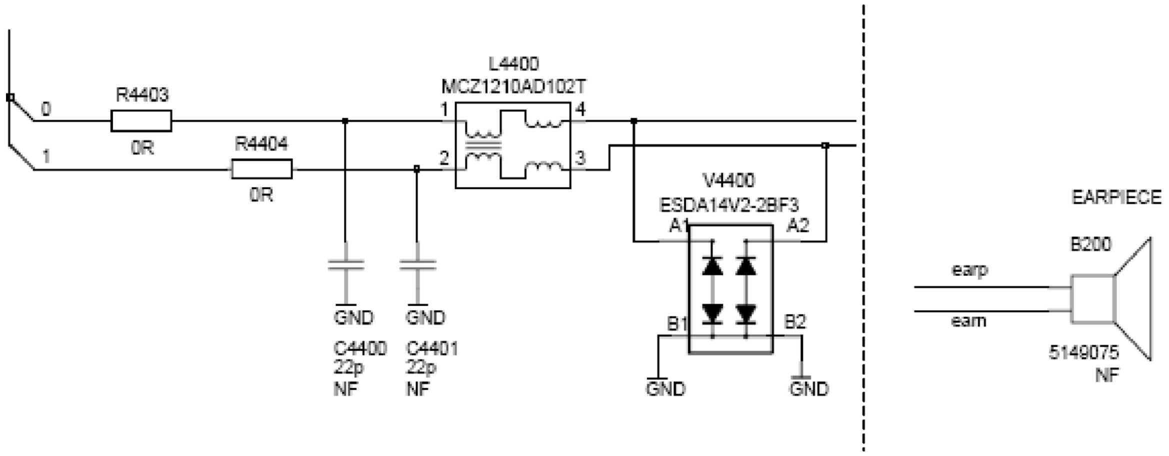

0
1
R4403
0R
R4404
0R
L4400
MCZ1210AD102T
1
4
2
3
GND
GND
C4400
22p
NF
C4401
22p
NF
V4400
ESDA14V2-2BF3
A1
A2
B1
B2
GND
GND
EARPIECE
B200
earp
earn
5149075
NF

Figure 44 Internal earpiece schematics

Internal speaker

The internal speakers are used in Internal HandsFree (IHF) call mode and for ringing tones. They can also be used for example with GPS navigation instructions or with Music Player. Two dynamic speakers are connected to the N2120 stereo amplifier. Signal to the amplifier comes from N2200 outputs XearL and XearR.

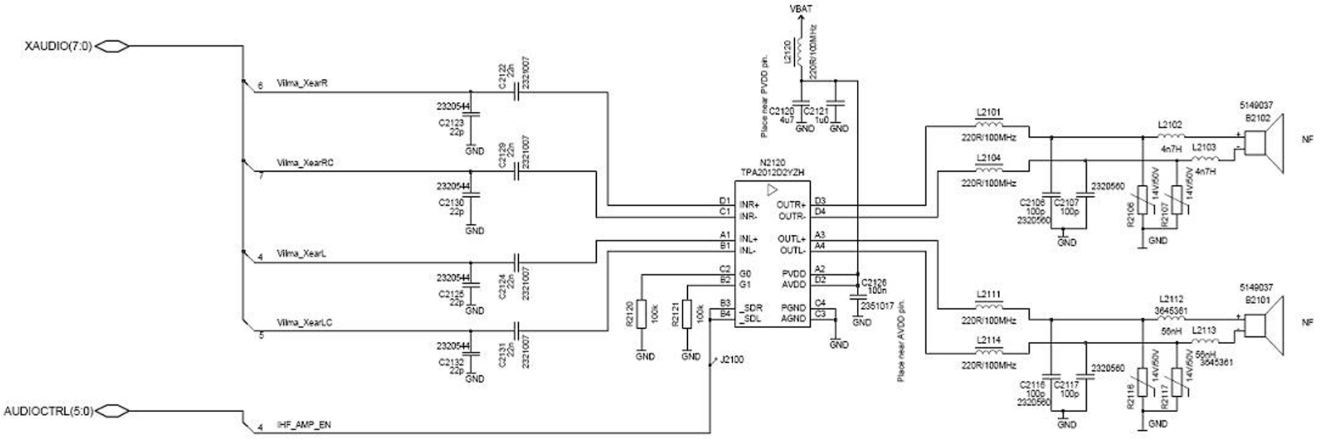

XAUDIO(7:0)
AUDIOCTRL(5:0)
6
Vilma_XearR
7
Vilma_XearRC
4
Vilma_XearL
5
Vilma_XearLC
4
IHF_AMP_EN
2320544
C2123
22p
GND
C2122
22n
2321007
2320544
C2130
22p
GND
C2129
22n
2321007
2320544
C2125
22p
GND
C2124
22n
2321007
2320544
C2132
22p
GND
C2131
22n
2321007
R2120
100k
GND
R2121
100k
GND
J2100
VBAT
L2120
220R/100MHz
Place near PVDD pin.
C2120
4u7
GND
C2121
1u0
GND
N2120
TPA2012D2YZH
D1
C1
A1
B1
C2
B2
B3
B4
INR+
INR-
INL+
INL-
G0
G1
_SDR
_SDL
OUTR+
OUTR-
OUTL+
OUTL-
PVDD
AVDD
PGND
AGND
D3
D4
A3
A4
A2
D2
C4
C3
C2126
100n
2351017
GND
GND
Place near AVDD pin.
L2101
220R/100MHz
L2104
220R/100MHz
C2106
100p
2320560
C2107
100p
2320560
GND
R2106
R2107
14V/50V
14V/50V
GND
L2102
4n7H
L2103
4n7H
5149037
B2102
NF
L2111
220R/100MHz
L2114
220R/100MHz
C2116
100p
2320560
C2117
100p
2320560
GND
R2116
R2117
14V/50V
14V/50V
GND
L2112
3645361
56nH
L2113
56nH
3645361
5149037
B2101
NF

Figure 45 Stereo IHF connection

External earpiece

All galvanic accessories are connected to the AV-connector. Any accessory with 3.5mm plug can be used. Accessory detection mechanism is described in separate chapter. Stereo signal to external earpiece comes from N2200 outputs XearL and XearR. Attenuation is needed before headphone amplifier in the use case where ringing tone is played from IHF speakers and earpiece simultaneously.

AV connector

The device has a 3.5mm AV-connector. The user can use it to connect any audio accessory or e.g. TV-out cable to the phone. In-box headset (HS-43) is so-called Enhancement Control Interface (ECI) accessory. If the connected cable is not ECI accessory, cable recognizing is based on impedance on the microphone line. If the cable cannot be recognized, the user can select which accessory type is connected to the phone.

There are five Audio Control lines from Cellular Modem ASIC D2800 to control control audio and AV-connector related electronics. Those signals and default stages of the signals are described in the following table.

Table 13 AUDIOCTRL interface

Signal	Control	Default state / action
AUDIOCTRL(0), AVPaEn	Headphone amplifier	0 (shutdown)
AUDIOCTRL(1), AVPlugDet	Plug_det from AV-connector	1.8V (VIO), grounded when 3.5mm plug inserted
AUDIOCTRL(2), AVECICtrl	Mic2P / head_det switch N2001	Default 0 (microphone line connected to Mic2P). When 1, microphone line connected to head_det -> ECI-detection
AUDIOCTRL(3), AVVideoCtrl	Mic2P / Comp_Video switch N2002	Default 0, (microphone line connected to Mic2P). When 1, Composite Video from APE connected to microphone line.
AUDIOCTRL(4), IHF_AMP_EN	Attenuation switches N2030 and N2031, IHF amp N2120	Default 0, IHF amplifier and attenuation not used.

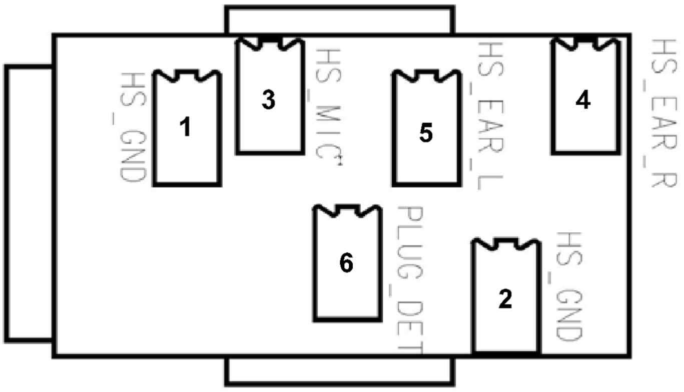


Figure 46 AV connector component layout and pads

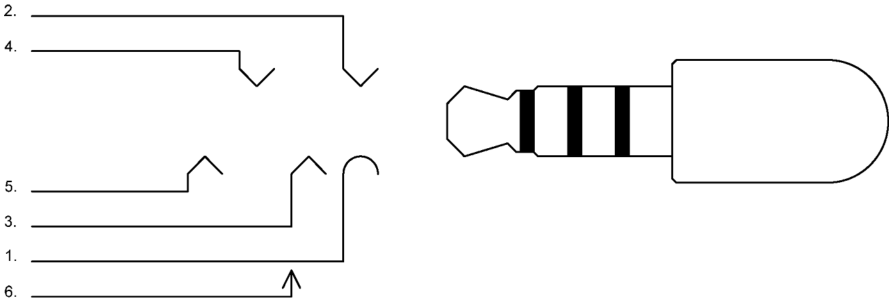


Figure 47 Connector pin layout (Plug conductors from left to right HS EAR L, HS EAR R, HS MIC/Cntrl. and HS GND)

Table 14 Pin configuration

3.5mm Pin #	Signal name	Direction	Description
6	PLUGDET	In	Terminal internal connection, plug detection
5	HS EAR L	In / Out	Audio output
4	HS EAR R	In / Out	Audio output,
3	HS MIC	In / Out	Multiplexed microphone audio and control data, C-video out
1, 2	HS GND	-	Ground contacts

There are three different use cases for AV connection. In all cases the PLUG_DET is used for detecting plug insertion and removal. EAR lines are used for FM antenna reception.

- **Headset or similar with ECI or without ECI.**

  When a headset is detected the terminal will check if there is ECI circuit in the accessory. If the ECI chip is present, tuning values for that is taken into use otherwise basic audio tuning parameters are used.

- **Headphones**

  For the headphones and any 3-pole connector devices, the headphones option is used.

  Note: The mic line and the ground line are connected together.

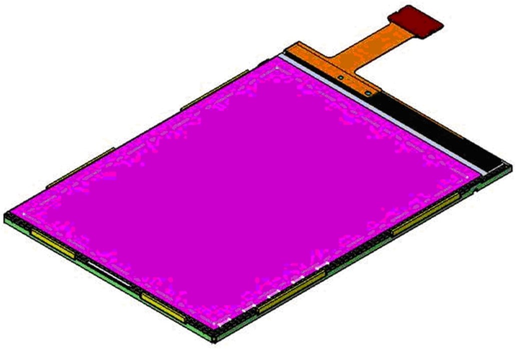
- **Video out**

  For example, when connecting terminal to television all pins are used.

  Note: The microphone is multiplexed to C-video. The cable has to be inserted first to television set and then to the terminal, otherwise the automatic detection does not work according to the specification.

User interface

Display



Display features

- Module size (width x height x thickness) 47.48 mm x 66.64 mm x 2.1 mm
- Resolution QVGA (240*320)
- Numbers of colours up to 16.7M
- Partial display function; power saving by pausing display process on part of the screen

- Built-in RAM capacity 240 columns x 320 rows x 24 bits RAM
- Transflective optics

The display has two different operating modes:

- Normal mode, Full screen, 16.7 million colors
- Partial idle mode, 8 colors but only part of the display is active

Display is located in the UI/Slide module. The interconnection between the LCD module and the UI-FPC implemented with a 24-pin board-to-board-connector.

The display is controlled via MeSSi-8 interface with an 8-bit bus by the application processor. All MeSSi signals go through the EMC filtering ASIPs (Z4406 and Z4405). The display module does not require any tunings in service.

Display and keyboard backlight

Display backlight LED's are connected in parallel in display module. Also the driver for display backlight LED's is integrated to the module itself. Display LED's brightness is controlled by application processor (D4800) via Messi interface. Automatic dimming functionality is integrated into display module itself.

The device uses discrete 'current pump' type LED driver (N1150) to drive S60 keyboard LED's, ITU keyboard LED's, multimedia keyboard LED's and side key LED's. All the backlight groups can be turned ON/OFF separately.

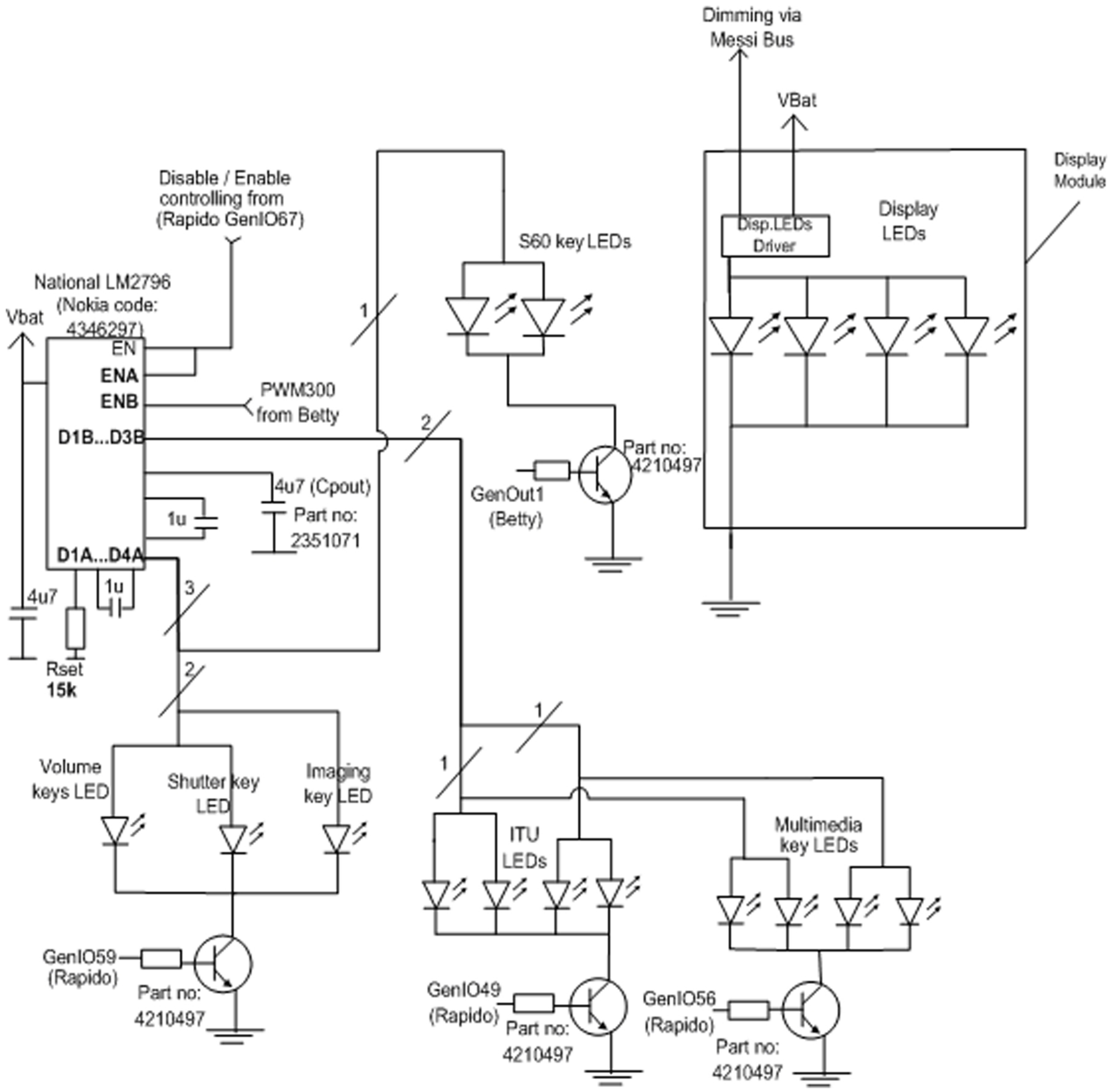

Dimming via
Messi Bus
VBat
Display
Module
Disp.LEDs
Driver
Display
LEDs
S60 key LEDs
Disable / Enable
controlling from
(Rapido GenIO67)
National LM2796
(Nokia code:
4346297)
Vbat
EN
ENA
ENB
PWM300
from Betty
D1B...D3B
1
2
Part no:
4210497
GenOut1
(Betty)
4u7 (Cpout)
Part no:
2351071
1u
D1A...D4A
1u
4u7
3
Rset
15k
2
1
1
Volume
keys LED
Shutter key
LED
Imaging
key LED
ITU
LEDs
Multimedia
key LEDs
GenIO59
(Rapido)
Part no:
4210497
GenIO49
(Rapido)
Part no:
4210497
GenIO56
(Rapido)
Part no:
4210497

Figure 48 Backlight circuitry

Ambient Light Sensor

Ambient Light Sensor is located in the UI/Slide module, in the upper part of the phone. It consists of the following components:

- Lightguide (part of UI/Slide module cover).
- Ambient Light Sensor (ALS). ALS is logarithmic, which response to light is similar to human eye. ALS is located on UI-FPC and it is not a spare part.
- Analog switch N4400, to turn on operating voltage VAUX to ALS only when needed.
- Pull-down resistor R4400 to convert current signal to voltage.

Ambient Light Sensor information is used to control backlights of the phone. Keyboard backlight is turned OFF, when they are not needed. Display backlight is dimmed, when environment lighting is dark. Outdoors, when environment is bright, display backlight is turned off. Ambient Light Sensor is calibrated in production. In service points, calibration is not possible.

Keyboard

The device has three separate keyboards:

- S60 keyboard
- ITU keyboard
- Multimedia keyboard

The S60 keyboard and multimedia keyboard are assembled on the UI/slide module. If there's failure on these parts, whole module has to be replaced. ITU keyboard pads are placed directly on the system/RF module.

ITU keyboard is visible, when display is moved upwards. Keypads are on the system/RF module. System/RF module includes also side keys (volume keys, imaging key and 2-position camera key).

Table 15 Keyboard matrix

	Col 0	**Col 1**	**Col 2**	**Col 3**	**Col 4**
Row 0	LeftSK	RightSK	NaviLEFT	NaviRIGHT	
Row 1	NaviSELECT	SEND	NaviUP	NaviDOWN	Vol Up
Row 2	7	2	8	3	#
Row 3	5	Cam Full	1	6	4
Row 4	9	*	Imaging	MK1	MK2
Row 5	End	Cam Half	Operator	MK3	MK4
Row 6	0	Edit	Clear	Apps	Vol Down

- Col 0-4 and Row 0-4 (except Multimedia keys) are filtered with ASIP Z4405.
- Row 5 and Row 6 are filtered with ASIP Z4406.
- Multimedia keys: Col 3 and Col4 are filtered with Z4400, Row 4 and Row 5 are filtered with Z4401.

Power key is also placed on the system/RF module. It connected directly to EM ASIC N2200 PWRONX PIN.

Slide position sensors

Two Hall sensors are used to detect slide movement upwards or downwards. One magnet triggers both sensors. The magnet is placed in the UI/slide module, under the display. The hall sensor, that detects opening of the ITU keyboard, is on the bottom side of the PWB. Opening the multimedia keyboard is detected with the hall sensor that is on the top of the PWB. Hall sensors are connected to the application ASIC (D4800) GPIO's.

RF description

Block diagram

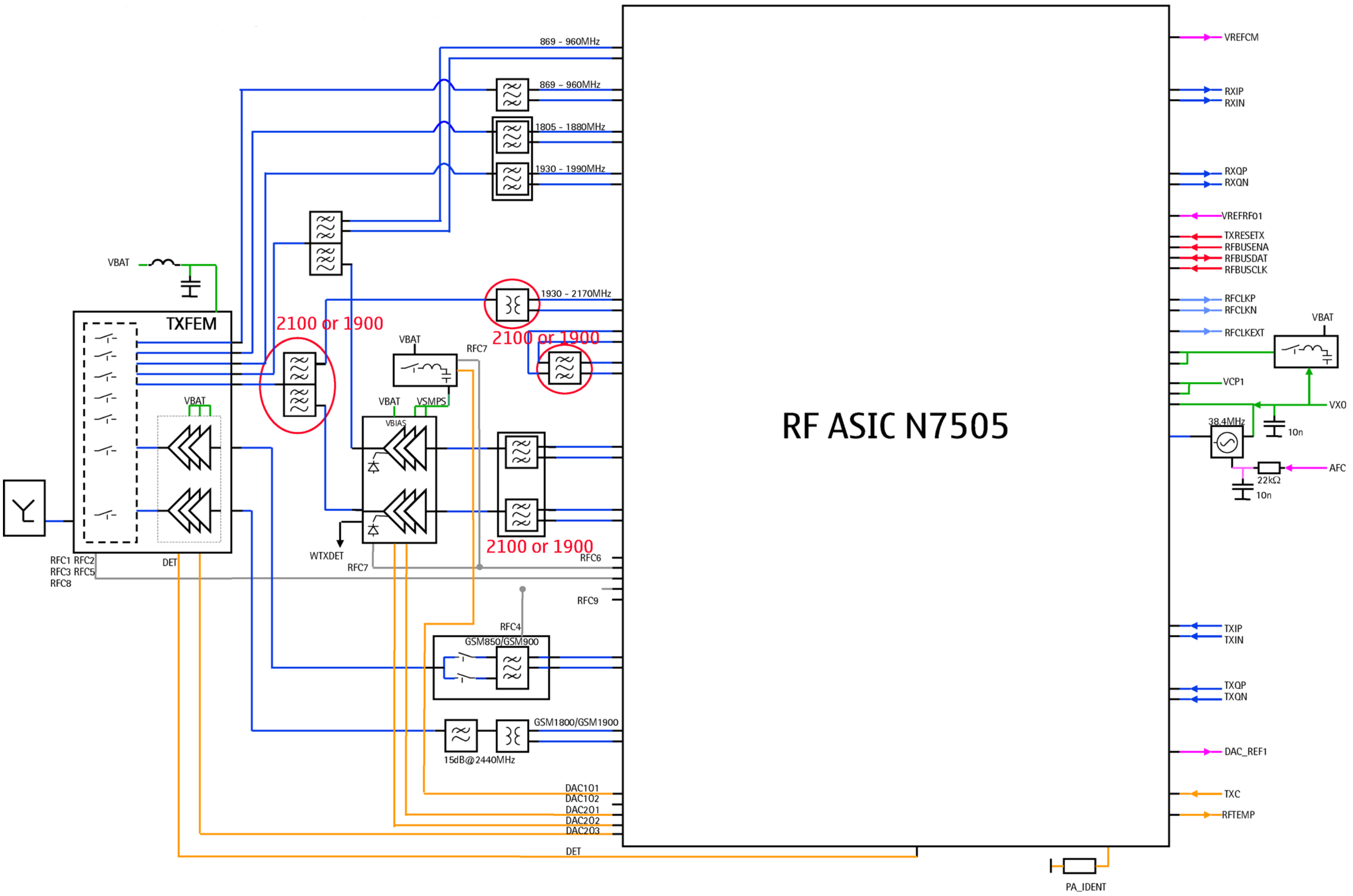

869 - 960MHz
869 - 960MHz
1805 - 1880MHz
1930 - 1990MHz
VBAT
TXFEM
2100 or 1900
1930 - 2170MHz
2100 or 1900
VBAT
RFC7
VBAT
VSMPS
VBIAS
VBAT
WTXDET
RFC7
2100 or 1900
RFC6
RFC1 RFC2
RFC3 RFC5
RFC8
DET
RFC9
RFC4
GSM850/GSM900
GSM1800/GSM1900
15dB@2440MHz
DAC101
DAC102
DAC201
DAC202
DAC203
DET
PA_IDENT
RF ASIC N7505
VREFCM
RXIP
RXIN
RXQP
RXQN
VREFRFO1
TXRESETX
RFBUSENA
RFBUSDAT
RFBUSCLK
RFCLKP
RFCLKN
RFCLKEXT
VBAT
VCP1
VX0
38.4MHz
10n
22kΩ
10n
AFC
TXIP
TXIN
TXQP
TXQN
DAC_REF1
TXC
RFTEMP

Figure 49 RF block diagram RM-320 using RF ASIC N7505

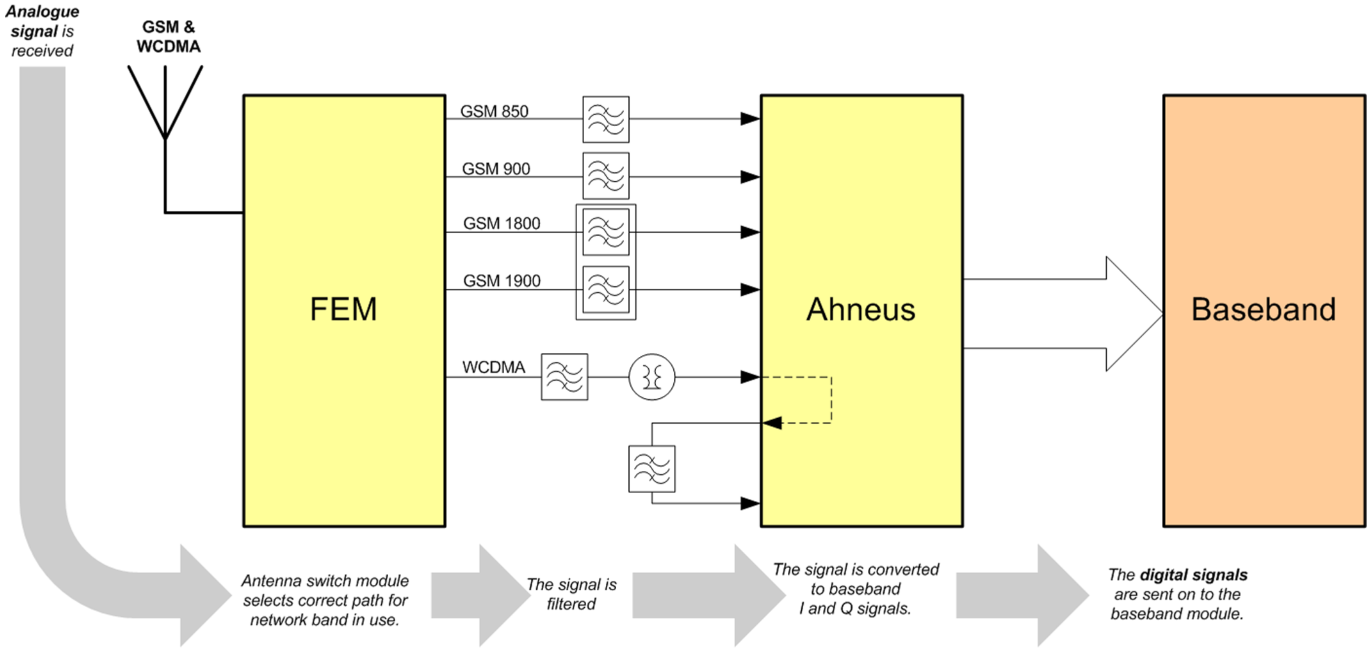
The RF block diagram for RM-320 uses RF ASIC N7505 that performs the RF back-end functions of receive and transmit function of the cellular transceiver.

Receiver (RX)

An analogue signal is received by the phone's antenna. The signal is converted to a digital signal and is then transferred further to the baseband (eg. to the earpiece).

The receiver functions are implemented in the RF ASIC.

Signals with different frequencies take different paths, therefore being handled by different components. The principle of GSM and WCDMA is the same.

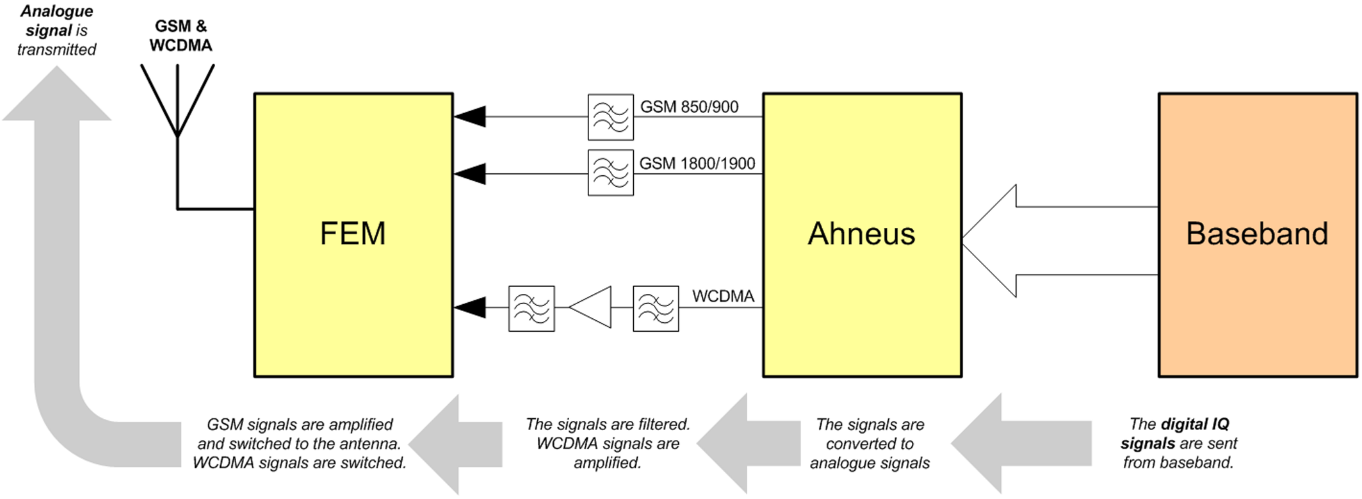

Analogue signal is received
GSM & WCDMA
FEM
GSM 850
GSM 900
GSM 1800
GSM 1900
WCDMA
Ahneus
Baseband
Antenna switch module selects correct path for network band in use.
The signal is filtered
The signal is converted to baseband I and Q signals.
The digital signals are sent on to the baseband module.

Transmitter (TX)

The digital baseband signal (eg. from the microphone) is converted to an analogue signal, which is then amplified and transmitted from the antenna. The frequency of this signal can be tuned to match the bandwith of the system in use (eg. GSM900).

The transmitter functions are implemented in the RF ASIC.

Even though the GSM and WCDMA signals are sent via different components, the principles of the transmission is the same.


Analogue signal is transmitted
GSM & WCDMA
FEM
GSM 850/900
GSM 1800/1900
WCDMA
Ahneus
Baseband
GSM signals are amplified and switched to the antenna. WCDMA signals are switched.
The signals are filtered. WCDMA signals are amplified.
The signals are converted to analogue signals
The digital IQ signals are sent from baseband.

Frequency mappings

GSM850 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	170	832.6	877.6	3330.4	3510.4	212	841.0	886.0	3364.0	3544.0
129	824.4	869.4	3297.6	3477.6	171	832.8	877.8	3331.2	3511.2	213	841.2	886.2	3364.8	3544.8
130	824.6	869.6	3298.4	3478.4	172	833.0	878.0	3332.0	3512.0	214	841.4	886.4	3365.6	3545.6
131	824.8	869.8	3299.2	3479.2	173	833.2	878.2	3332.8	3512.8	215	841.6	886.6	3366.4	3546.4
132	825.0	870.0	3300.0	3480.0	174	833.4	878.4	3333.6	3513.6	216	841.8	886.8	3367.2	3547.2
133	825.2	870.2	3300.8	3480.8	175	833.6	878.6	3334.4	3514.4	217	842.0	887.0	3368.0	3548.0
134	825.4	870.4	3301.6	3481.6	176	833.8	878.8	3335.2	3515.2	218	842.2	887.2	3368.8	3548.8
135	825.6	870.6	3302.4	3482.4	177	834.0	879.0	3336.0	3516.0	219	842.4	887.4	3369.6	3549.6
136	825.8	870.8	3303.2	3483.2	178	834.2	879.2	3336.8	3516.8	220	842.6	887.6	3370.4	3550.4
137	826.0	871.0	3304.0	3484.0	179	834.4	879.4	3337.6	3517.6	221	842.8	887.8	3371.2	3551.2
138	826.2	871.2	3304.8	3484.8	180	834.6	879.6	3338.4	3518.4	222	843.0	888.0	3372.0	3552.0
139	826.4	871.4	3305.6	3485.6	181	834.8	879.8	3339.2	3519.2	223	843.2	888.2	3372.8	3552.8
140	826.6	871.6	3306.4	3486.4	182	835.0	880.0	3340.0	3520.0	224	843.4	888.4	3373.6	3553.6
141	826.8	871.8	3307.2	3487.2	183	835.2	880.2	3340.8	3520.8	225	843.6	888.6	3374.4	3554.4
142	827.0	872.0	3308.0	3488.0	184	835.4	880.4	3341.6	3521.6	226	843.8	888.8	3375.2	3555.2
143	827.2	872.2	3308.8	3488.8	185	835.6	880.6	3342.4	3522.4	227	844.0	889.0	3376.0	3556.0
144	827.4	872.4	3309.6	3489.6	186	835.8	880.8	3343.2	3523.2	228	844.2	889.2	3376.8	3556.8
145	827.6	872.6	3310.4	3490.4	187	836.0	881.0	3344.0	3524.0	229	844.4	889.4	3377.6	3557.6
146	827.8	872.8	3311.2	3491.2	188	836.2	881.2	3344.8	3524.8	230	844.6	889.6	3378.4	3558.4
147	828.0	873.0	3312.0	3492.0	189	836.4	881.4	3345.6	3525.6	231	844.8	889.8	3379.2	3559.2
148	828.2	873.2	3312.8	3492.8	190	836.6	881.6	3346.4	3526.4	232	845.0	890.0	3380.0	3560.0
149	828.4	873.4	3313.6	3493.6	191	836.8	881.8	3347.2	3527.2	233	845.2	890.2	3380.8	3560.8
150	828.6	873.6	3314.4	3494.4	192	837.0	882.0	3348.0	3528.0	234	845.4	890.4	3381.6	3561.6
151	828.8	873.8	3315.2	3495.2	193	837.2	882.2	3348.8	3528.8	235	845.6	890.6	3382.4	3562.4
152	829.0	874.0	3316.0	3496.0	194	837.4	882.4	3349.6	3529.6	236	845.8	890.8	3383.2	3563.2
153	829.2	874.2	3316.8	3496.8	195	837.6	882.6	3350.4	3530.4	237	846.0	891.0	3384.0	3564.0
154	829.4	874.4	3317.6	3497.6	196	837.8	882.8	3351.2	3531.2	238	846.2	891.2	3384.8	3564.8
155	829.6	874.6	3318.4	3498.4	197	838.0	883.0	3352.0	3532.0	239	846.4	891.4	3385.6	3565.6
156	829.8	874.8	3319.2	3499.2	198	838.2	883.2	3352.8	3532.8	240	846.6	891.6	3386.4	3566.4
157	830.0	875.0	3320.0	3500.0	199	838.4	883.4	3353.6	3533.6	241	846.8	891.8	3387.2	3567.2
158	830.2	875.2	3320.8	3500.8	200	838.6	883.6	3354.4	3534.4	242	847.0	892.0	3388.0	3568.0
159	830.4	875.4	3321.6	3501.6	201	838.8	883.8	3355.2	3535.2	243	847.2	892.2	3388.8	3568.8
160	830.6	875.6	3322.4	3502.4	202	839.0	884.0	3356.0	3536.0	244	847.4	892.4	3389.6	3569.6
161	830.8	875.8	3323.2	3503.2	203	839.2	884.2	3356.8	3536.8	245	847.6	892.6	3390.4	3570.4
162	831.0	876.0	3324.0	3504.0	204	839.4	884.4	3357.6	3537.6	246	847.8	892.8	3391.2	3571.2
163	831.2	876.2	3324.8	3504.8	205	839.6	884.6	3358.4	3538.4	247	848.0	893.0	3392.0	3572.0
164	831.4	876.4	3325.6	3505.6	206	839.8	884.8	3359.2	3539.2	248	848.2	893.2	3392.8	3572.8
165	831.6	876.6	3326.4	3506.4	207	840.0	885.0	3360.0	3540.0	249	848.4	893.4	3393.6	3573.6
166	831.8	876.8	3327.2	3507.2	208	840.2	885.2	3360.8	3540.8	250	848.6	893.6	3394.4	3574.4
167	832.0	877.0	3328.0	3508.0	209	840.4	885.4	3361.6	3541.6	251	848.8	893.8	3395.2	3575.2

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	849	1777.6	1872.6	3555.2	3745.2
569	1721.6	1816.6	3443.2	3633.2	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	850	1777.8	1872.8	3555.6	3745.6
570	1721.8	1816.8	3443.6	3633.6	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	851	1778.0	1873.0	3556.0	3746.0
571	1722.0	1817.0	3444.0	3634.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	852	1778.2	1873.2	3556.4	3746.4
572	1722.2	1817.2	3444.4	3634.4	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	853	1778.4	1873.4	3556.8	3746.8
573	1722.4	1817.4	3444.8	3634.8	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	854	1778.6	1873.6	3557.2	3747.2
574	1722.6	1817.6	3445.2	3635.2	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	855	1778.8	1873.8	3557.6	3747.6
575	1722.8	1817.8	3445.6	3635.6	669	1741.6	1836.6	3483.2	3673.2	763	1760.4	1855.4	3520.8	3710.8	856	1779.0	1874.0	3558.0	3748.0
576	1723.0	1818.0	3446.0	3636.0	670	1741.8	1836.8	3483.6	3673.6	764	1760.6	1855.6	3521.2	3711.2	857	1779.2	1874.2	3558.4	3748.4
577	1723.2	1818.2	3446.4	3636.4	671	1742.0	1837.0	3484.0	3674.0	765	1760.8	1855.8	3521.6	3711.6	858	1779.4	1874.4	3558.8	3748.8
578	1723.4	1818.4	3446.8	3636.8	672	1742.2	1837.2	3484.4	3674.4	766	1761.0	1856.0	3522.0	3712.0	859	1779.6	1874.6	3559.2	3749.2
579	1723.6	1818.6	3447.2	3637.2	673	1742.4	1837.4	3484.8	3674.8	767	1761.2	1856.2	3522.4	3712.4	860	1779.8	1874.8	3559.6	3749.6
580	1723.8	1818.8	3447.6	3637.6	674	1742.6	1837.6	3485.2	3675.2	768	1761.4	1856.4	3522.8	3712.8	861	1780.0	1875.0	3560.0	3750.0
581	1724.0	1819.0	3448.0	3638.0	675	1742.8	1837.8	3485.6	3675.6	769	1761.6	1856.6	3523.2	3713.2	862	1780.2	1875.2	3560.4	3750.4
582	1724.2	1819.2	3448.4	3638.4	676	1743.0	1838.0	3486.0	3676.0	770	1761.8	1856.8	3523.6	3713.6	863	1780.4	1875.4	3560.8	3750.8
583	1724.4	1819.4	3448.8	3638.8	677	1743.2	1838.2	3486.4	3676.4	771	1762.0	1857.0	3524.0	3714.0	864	1780.6	1875.6	3561.2	3751.2
584	1724.6	1819.6	3449.2	3639.2	678	1743.4	1838.4	3486.8	3676.8	772	1762.2	1857.2	3524.4	3714.4	865	1780.8	1875.8	3561.6	3751.6
585	1724.8	1819.8	3449.6	3639.6	679	1743.6	1838.6	3487.2	3677.2	773	1762.4	1857.4	3524.8	3714.8	866	1781.0	1876.0	3562.0	3752.0
586	1725.0	1820.0	3450.0	3640.0	680	1743.8	1838.8	3487.6	3677.6	774	1762.6	1857.6	3525.2	3715.2	867	1781.2	1876.2	3562.4	3752.4
587	1725.2	1820.2	3450.4	3640.4	681	1744.0	1839.0	3488.0	3678.0	775	1762.8	1857.8	3525.6	3715.6	868	1781.4	1876.4	3562.8	3752.8
588	1725.4	1820.4	3450.8	3640.8	682	1744.2	1839.2	3488.4	3678.4	776	1763.0	1858.0	3526.0	3716.0	869	1781.6	1876.6	3563.2	3753.2
589	1725.6	1820.6	3451.2	3641.2	683	1744.4	1839.4	3488.8	3678.8	777	1763.2	1858.2	3526.4	3716.4	870	1781.8	1876.8	3563.6	3753.6
590	1725.8	1820.8	3451.6	3641.6	684	1744.6	1839.6	3489.2	3679.2	778	1763.4	1858.4	3526.8	3716.8	871	1782.0	1877.0	3564.0	3754.0
591	1726.0	1821.0	3452.0	3642.0	685	1744.8	1839.8	3489.6	3679.6	779	1763.6	1858.6	3527.2	3717.2	872	1782.2	1877.2	3564.4	3754.4
592	1726.2	1821.2	3452.4	3642.4	686	1745.0	1840.0	3490.0	3680.0	780	1763.8	1858.8	3527.6	3717.6	873	1782.4	1877.4	3564.8	3754.8
593	1726.4	1821.4	3452.8	3642.8	687	1745.2	1840.2	3490.4	3680.4	781	1764.0	1859.0	3528.0	3718.0	874	1782.6	1877.6	3565.2	3755.2
594	1726.6	1821.6	3453.2	3643.2	688	1745.4	1840.4	3490.8	3680.8	782	1764.2	1859.2	3528.4	3718.4	875	1782.8	1877.8	3565.6	3755.6
595	1726.8	1821.8	3453.6	3643.6	689	1745.6	1840.6	3491.2	3681.2	783	1764.4	1859.4	3528.8	3718.8	876	1783.0	1878.0	3566.0	3756.0
596	1727.0	1822.0	3454.0	3644.0	690	1745.8	1840.8	3491.6	3681.6	784	1764.6	1859.6	3529.2	3719.2	877	1783.2	1878.2	3566.4	3756.4
597	1727.2	1822.2	3454.4	3644.4	691	1746.0	1841.0	3492.0	3682.0	785	1764.8	1859.8	3529.6	3719.6	878	1783.4	1878.4	3566.8	3756.8
598	1727.4	1822.4	3454.8	3644.8	692	1746.2	1841.2	3492.4	3682.4	786	1765.0	1860.0	3530.0	3720.0	879	1783.6	1878.6	3567.2	3757.2
599	1727.6	1822.6	3455.2	3645.2	693	1746.4	1841.4	3492.8	3682.8	787	1765.2	1860.2	3530.4	3720.4	880	1783.8	1878.8	3567.6	3757.6
600	1727.8	1822.8	3455.6	3645.6	694	1746.6	1841.6	3493.2	3683.2	788	1765.4	1860.4	3530.8	3720.8	881	1784.0	1879.0	3568.0	3758.0
601	1728.0	1823.0	3456.0	3646.0	695	1746.8	1841.8	3493.6	3683.6	789	1765.6	1860.6	3531.2	3721.2	882	1784.2	1879.2	3568.4	3758.4
602	1728.2	1823.2	3456.4	3646.4	696	1747.0	1842.0	3494.0	3684.0	790	1765.8	1860.8	3531.6	3721.6	883	1784.4	1879.4	3568.8	3758.8
603	1728.4	1823.4	3456.8	3646.8	697	1747.2	1842.2	3494.4	3684.4	791	1766.0	1861.0	3532.0	3722.0	884	1784.6	1879.6	3569.2	3759.2
604	1728.6	1823.6	3457.2	3647.2	698	1747.4	1842.4	3494.8	3684.8	792	1766.2	1861.2	3532.4	3722.4	885	1784.8	1879.8	3569.6	3759.6
605	1728.8	1823.8	3457.6	3647.6	699	1747.6	1842.6	3495.2	3685.2										

GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

WCDMA 2100 Rx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
10562	2112.4	4224.8	10625	2125	4250	10688	2137.6	4275.2	10751	2150.2	4300.4	10814	2162.8	4325.6
10563	2112.6	4225.2	10626	2125.2	4250.4	10689	2137.8	4275.6	10752	2150.4	4300.8	10815	2163	4326
10564	2112.8	4225.6	10627	2125.4	4250.8	10690	2138	4276	10753	2150.6	4301.2	10816	2163.2	4326.4
10565	2113	4226	10628	2125.6	4251.2	10691	2138.2	4276.4	10754	2150.8	4301.6	10817	2163.4	4326.8
10566	2113.2	4226.4	10629	2125.8	4251.6	10692	2138.4	4276.8	10755	2151	4302	10818	2163.6	4327.2
10567	2113.4	4226.8	10630	2126	4252	10693	2138.6	4277.2	10756	2151.2	4302.4	10819	2163.8	4327.6
10568	2113.6	4227.2	10631	2126.2	4252.4	10694	2138.8	4277.6	10757	2151.4	4302.8	10820	2164	4328
10569	2113.8	4227.6	10632	2126.4	4252.8	10695	2139	4278	10758	2151.6	4303.2	10821	2164.2	4328.4
10570	2114	4228	10633	2126.6	4253.2	10696	2139.2	4278.4	10759	2151.8	4303.6	10822	2164.4	4328.8
10571	2114.2	4228.4	10634	2126.8	4253.6	10697	2139.4	4278.8	10760	2152	4304	10823	2164.6	4329.2
10572	2114.4	4228.8	10635	2127	4254	10698	2139.6	4279.2	10761	2152.2	4304.4	10824	2164.8	4329.6
10573	2114.6	4229.2	10636	2127.2	4254.4	10699	2139.8	4279.6	10762	2152.4	4304.8	10825	2165	4330
10574	2114.8	4229.6	10637	2127.4	4254.8	10700	2140	4280	10763	2152.6	4305.2	10826	2165.2	4330.4
10575	2115	4230	10638	2127.6	4255.2	10701	2140.2	4280.4	10764	2152.8	4305.6	10827	2165.4	4330.8
10576	2115.2	4230.4	10639	2127.8	4255.6	10702	2140.4	4280.8	10765	2153	4306	10828	2165.6	4331.2
10577	2115.4	4230.8	10640	2128	4256	10703	2140.6	4281.2	10766	2153.2	4306.4	10829	2165.8	4331.6
10578	2115.6	4231.2	10641	2128.2	4256.4	10704	2140.8	4281.6	10767	2153.4	4306.8	10830	2166	4332
10579	2115.8	4231.6	10642	2128.4	4256.8	10705	2141	4282	10768	2153.6	4307.2	10831	2166.2	4332.4
10580	2116	4232	10643	2128.6	4257.2	10706	2141.2	4282.4	10769	2153.8	4307.6	10832	2166.4	4332.8
10581	2116.2	4232.4	10644	2128.8	4257.6	10707	2141.4	4282.8	10770	2154	4308	10833	2166.6	4333.2
10582	2116.4	4232.8	10645	2129	4258	10708	2141.6	4283.2	10771	2154.2	4308.4	10834	2166.8	4333.6
10583	2116.6	4233.2	10646	2129.2	4258.4	10709	2141.8	4283.6	10772	2154.4	4308.8	10835	2167	4334
10584	2116.8	4233.6	10647	2129.4	4258.8	10710	2142	4284	10773	2154.6	4309.2	10836	2167.2	4334.4
10585	2117	4234	10648	2129.6	4259.2	10711	2142.2	4284.4	10774	2154.8	4309.6	10837	2167.4	4334.8
10586	2117.2	4234.4	10649	2129.8	4259.6	10712	2142.4	4284.8	10775	2155	4310	10838	2167.6	4335.2
10587	2117.4	4234.8	10650	2130	4260	10713	2142.6	4285.2	10776	2155.2	4310.4			
10588	2117.6	4235.2	10651	2130.2	4260.4	10714	2142.8	4285.6	10777	2155.4	4310.8			
10589	2117.8	4235.6	10652	2130.4	4260.8	10715	2143	4286	10778	2155.6	4311.2			
10590	2118	4236	10653	2130.6	4261.2	10716	2143.2	4286.4	10779	2155.8	4311.6			
10591	2118.2	4236.4	10654	2130.8	4261.6	10717	2143.4	4286.8	10780	2156	4312			
10592	2118.4	4236.8	10655	2131	4262	10718	2143.6	4287.2	10781	2156.2	4312.4			
10593	2118.6	4237.2	10656	2131.2	4262.4	10719	2143.8	4287.6	10782	2156.4	4312.8			
10594	2118.8	4237.6	10657	2131.4	4262.8	10720	2144	4288	10783	2156.6	4313.2			
10595	2119	4238	10658	2131.6	4263.2	10721	2144.2	4288.4	10784	2156.8	4313.6			
10596	2119.2	4238.4	10659	2131.8	4263.6	10722	2144.4	4288.8	10785	2157	4314			
10597	2119.4	4238.8	10660	2132	4264	10723	2144.6	4289.2	10786	2157.2	4314.4			
10598	2119.6	4239.2	10661	2132.2	4264.4	10724	2144.8	4289.6	10787	2157.4	4314.8			
10599	2119.8	4239.6	10662	2132.4	4264.8	10725	2145	4290	10788	2157.6	4315.2			
10600	2120	4240	10663	2132.6	4265.2	10726	2145.2	4290.4	10789	2157.8	4315.6			
10601	2120.2	4240.4	10664	2132.8	4265.6	10727	2145.4	4290.8	10790	2158	4316			
10602	2120.4	4240.8	10665	2133	4266	10728	2145.6	4291.2	10791	2158.2	4316.4			
10603	2120.6	4241.2	10666	2133.2	4266.4	10729	2145.8	4291.6	10792	2158.4	4316.8			
10604	2120.8	4241.6	10667	2133.4	4266.8	10730	2146	4292	10793	2158.6	4317.2			
10605	2121	4242	10668	2133.6	4267.2	10731	2146.2	4292.4	10794	2158.8	4317.6			
10606	2121.2	4242.4	10669	2133.8	4267.6	10732	2146.4	4292.8	10795	2159	4318			
10607	2121.4	4242.8	10670	2134	4268	10733	2146.6	4293.2	10796	2159.2	4318.4			
10608	2121.6	4243.2	10671	2134.2	4268.4	10734	2146.8	4293.6	10797	2159.4	4318.8			
10609	2121.8	4243.6	10672	2134.4	4268.8	10735	2147	4294	10798	2159.6	4319.2			
10610	2122	4244	10673	2134.6	4269.2	10736	2147.2	4294.4	10799	2159.8	4319.6			
10611	2122.2	4244.4	10674	2134.8	4269.6	10737	2147.4	4294.8	10800	2160	4320			
10612	2122.4	4244.8	10675	2135	4270	10738	2147.6	4295.2	10801	2160.2	4320.4			
10613	2122.6	4245.2	10676	2135.2	4270.4	10739	2147.8	4295.6	10802	2160.4	4320.8			
10614	2122.8	4245.6	10677	2135.4	4270.8	10740	2148	4296	10803	2160.6	4321.2			
10615	2123	4246	10678	2135.6	4271.2	10741	2148.2	4296.4	10804	2160.8	4321.6			
10616	2123.2	4246.4	10679	2135.8	4271.6	10742	2148.4	4296.8	10805	2161	4322			
10617	2123.4	4246.8	10680	2136	4272	10743	2148.6	4297.2	10806	2161.2	4322.4			
10618	2123.6	4247.2	10681	2136.2	4272.4	10744	2148.8	4297.6	10807	2161.4	4322.8			
10619	2123.8	4247.6	10682	2136.4	4272.8	10745	2149	4298	10808	2161.6	4323.2			
10620	2124	4248	10683	2136.6	4273.2	10746	2149.2	4298.4	10809	2161.8	4323.6			
10621	2124.2	4248.4	10684	2136.8	4273.6	10747	2149.4	4298.8	10810	2162	4324			
10622	2124.4	4248.8	10685	2137	4274	10748	2149.6	4299.2	10811	2162.2	4324.4			
10623	2124.6	4249.2	10686	2137.2	4274.4	10749	2149.8	4299.6	10812	2162.4	4324.8			
10624	2124.8	4249.6	10687	2137.4	4274.8	10750	2150	4300	10813	2162.6	4325.2			

WCDMA 2100 Tx frequencies

Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx
9612	1922.4	3844.8	9671	1934.2	3868.4	9730	1946	3892	9789	1957.8	3915.6	9848	1969.6	3939.2
9613	1922.6	3845.2	9672	1934.4	3868.8	9731	1946.2	3892.4	9790	1958	3916	9849	1969.8	3939.6
9614	1922.8	3845.6	9673	1934.6	3869.2	9732	1946.4	3892.8	9791	1958.2	3916.4	9850	1970	3940
9615	1923	3846	9674	1934.8	3869.6	9733	1946.6	3893.2	9792	1958.4	3916.8	9851	1970.2	3940.4
9616	1923.2	3846.4	9675	1935	3870	9734	1946.8	3893.6	9793	1958.6	3917.2	9852	1970.4	3940.8
9617	1923.4	3846.8	9676	1935.2	3870.4	9735	1947	3894	9794	1958.8	3917.6	9853	1970.6	3941.2
9618	1923.6	3847.2	9677	1935.4	3870.8	9736	1947.2	3894.4	9795	1959	3918	9854	1970.8	3941.6
9619	1923.8	3847.6	9678	1935.6	3871.2	9737	1947.4	3894.8	9796	1959.2	3918.4	9855	1971	3942
9620	1924	3848	9679	1935.8	3871.6	9738	1947.6	3895.2	9797	1959.4	3918.8	9856	1971.2	3942.4
9621	1924.2	3848.4	9680	1936	3872	9739	1947.8	3895.6	9798	1959.6	3919.2	9857	1971.4	3942.8
9622	1924.4	3848.8	9681	1936.2	3872.4	9740	1948	3896	9799	1959.8	3919.6	9858	1971.6	3943.2
9623	1924.6	3849.2	9682	1936.4	3872.8	9741	1948.2	3896.4	9800	1960	3920	9859	1971.8	3943.6
9624	1924.8	3849.6	9683	1936.6	3873.2	9742	1948.4	3896.8	9801	1960.2	3920.4	9860	1972	3944
9625	1925	3850	9684	1936.8	3873.6	9743	1948.6	3897.2	9802	1960.4	3920.8	9861	1972.2	3944.4
9626	1925.2	3850.4	9685	1937	3874	9744	1948.8	3897.6	9803	1960.6	3921.2	9862	1972.4	3944.8
9627	1925.4	3850.8	9686	1937.2	3874.4	9745	1949	3898	9804	1960.8	3921.6	9863	1972.6	3945.2
9628	1925.6	3851.2	9687	1937.4	3874.8	9746	1949.2	3898.4	9805	1961	3922	9864	1972.8	3945.6
9629	1925.8	3851.6	9688	1937.6	3875.2	9747	1949.4	3898.8	9806	1961.2	3922.4	9865	1973	3946
9630	1926	3852	9689	1937.8	3875.6	9748	1949.6	3899.2	9807	1961.4	3922.8	9866	1973.2	3946.4
9631	1926.2	3852.4	9690	1938	3876	9749	1949.8	3899.6	9808	1961.6	3923.2	9867	1973.4	3946.8
9632	1926.4	3852.8	9691	1938.2	3876.4	9750	1950	3900	9809	1961.8	3923.6	9868	1973.6	3947.2
9633	1926.6	3853.2	9692	1938.4	3876.8	9751	1950.2	3900.4	9810	1962	3924	9869	1973.8	3947.6
9634	1926.8	3853.6	9693	1938.6	3877.2	9752	1950.4	3900.8	9811	1962.2	3924.4	9870	1974	3948
9635	1927	3854	9694	1938.8	3877.6	9753	1950.6	3901.2	9812	1962.4	3924.8	9871	1974.2	3948.4
9636	1927.2	3854.4	9695	1939	3878	9754	1950.8	3901.6	9813	1962.6	3925.2	9872	1974.4	3948.8
9637	1927.4	3854.8	9696	1939.2	3878.4	9755	1951	3902	9814	1962.8	3925.6	9873	1974.6	3949.2
9638	1927.6	3855.2	9697	1939.4	3878.8	9756	1951.2	3902.4	9815	1963	3926	9874	1974.8	3949.6
9639	1927.8	3855.6	9698	1939.6	3879.2	9757	1951.4	3902.8	9816	1963.2	3926.4	9875	1975	3950
9640	1928	3856	9699	1939.8	3879.6	9758	1951.6	3903.2	9817	1963.4	3926.8	9876	1975.2	3950.4
9641	1928.2	3856.4	9700	1940	3880	9759	1951.8	3903.6	9818	1963.6	3927.2	9877	1975.4	3950.8
9642	1928.4	3856.8	9701	1940.2	3880.4	9760	1952	3904	9819	1963.8	3927.6	9878	1975.6	3951.2
9643	1928.6	3857.2	9702	1940.4	3880.8	9761	1952.2	3904.4	9820	1964	3928	9879	1975.8	3951.6
9644	1928.8	3857.6	9703	1940.6	3881.2	9762	1952.4	3904.8	9821	1964.2	3928.4	9880	1976	3952
9645	1929	3858	9704	1940.8	3881.6	9763	1952.6	3905.2	9822	1964.4	3928.8	9881	1976.2	3952.4
9646	1929.2	3858.4	9705	1941	3882	9764	1952.8	3905.6	9823	1964.6	3929.2	9882	1976.4	3952.8
9647	1929.4	3858.8	9706	1941.2	3882.4	9765	1953	3906	9824	1964.8	3929.6	9883	1976.6	3953.2
9648	1929.6	3859.2	9707	1941.4	3882.8	9766	1953.2	3906.4	9825	1965	3930	9884	1976.8	3953.6
9649	1929.8	3859.6	9708	1941.6	3883.2	9767	1953.4	3906.8	9826	1965.2	3930.4	9885	1977	3954
9650	1930	3860	9709	1941.8	3883.6	9768	1953.6	3907.2	9827	1965.4	3930.8	9886	1977.2	3954.4
9651	1930.2	3860.4	9710	1942	3884	9769	1953.8	3907.6	9828	1965.6	3931.2	9887	1977.4	3954.8
9652	1930.4	3860.8	9711	1942.2	3884.4	9770	1954	3908	9829	1965.8	3931.6	9888	1977.6	3955.2
9653	1930.6	3861.2	9712	1942.4	3884.8	9771	1954.2	3908.4	9830	1966	3932			
9654	1930.8	3861.6	9713	1942.6	3885.2	9772	1954.4	3908.8	9831	1966.2	3932.4			
9655	1931	3862	9714	1942.8	3885.6	9773	1954.6	3909.2	9832	1966.4	3932.8			
9656	1931.2	3862.4	9715	1943	3886	9774	1954.8	3909.6	9833	1966.6	3933.2			
9657	1931.4	3862.8	9716	1943.2	3886.4	9775	1955	3910	9834	1966.8	3933.6			
9658	1931.6	3863.2	9717	1943.4	3886.8	9776	1955.2	3910.4	9835	1967	3934			
9659	1931.8	3863.6	9718	1943.6	3887.2	9777	1955.4	3910.8	9836	1967.2	3934.4			
9660	1932	3864	9719	1943.8	3887.6	9778	1955.6	3911.2	9837	1967.4	3934.8			
9661	1932.2	3864.4	9720	1944	3888	9779	1955.8	3911.6	9838	1967.6	3935.2			
9662	1932.4	3864.8	9721	1944.2	3888.4	9780	1956	3912	9839	1967.8	3935.6			
9663	1932.6	3865.2	9722	1944.4	3888.8	9781	1956.2	3912.4	9840	1968	3936			
9664	1932.8	3865.6	9723	1944.6	3889.2	9782	1956.4	3912.8	9841	1968.2	3936.4			
9665	1933	3866	9724	1944.8	3889.6	9783	1956.6	3913.2	9842	1968.4	3936.8			
9666	1933.2	3866.4	9725	1945	3890	9784	1956.8	3913.6	9843	1968.6	3937.2			
9667	1933.4	3866.8	9726	1945.2	3890.4	9785	1957	3914	9844	1968.8	3937.6			
9668	1933.6	3867.2	9727	1945.4	3890.8	9786	1957.2	3914.4	9845	1969	3938			
9669	1933.8	3867.6	9728	1945.6	3891.2	9787	1957.4	3914.8	9846	1969.2	3938.4			
9670	1934	3868	9729	1945.8	3891.6	9788	1957.6	3915.2	9847	1969.4	3938.8			

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